Resource Resiliency:
preparing rural America for an uncertain climatic future through community design and ecosystem service provision

by

Mikey Goralnik

A Masters Project submitted to the faculty
of the University of North Carolina at Chapel Hill
in partial fulfillment of the requirements
for the degree of Master of City and Regional Planning
in the Department of City and Regional Planning

Chapel Hill

2015

Approved by:

READER (optional) PRINT NAME ADVISOR SIGNATURE

RESOURCE RESILIENCY

preparing rural America for an uncertain climatic future through community design and ecosystem service provision

by Mikey Goralnik

This project explores planning and design mechanisms that can blend ecological and human resources to achieve community resiliency in a rural context.

This chapter makes the case for an increased acknowledgement of rural issues in planning and designing for resiliency. I contrast the recent explosion of attention paid to urban resiliency by planners, designers, and the general public with the lack of recognition and resources committed to rural resiliency issues in the US. I propose that despite the virtually infinite permutations of cultural and ecological contexts that distinguish rural communities throughout the US, there are nationwide similarities in both issues faced and potential responses to those issues.

IMPERATIVE

This chapter begins with that same broad perspective. I outline some of the uniquely rural dimensions of a changing climate, and discuss the environmental justice concerns associated with planning and designing for resiliency in rural America. Then, I hone in on how one community—Kinston, North Carolina—has grappled with these issues, both benefitting from and struggling with federal efforts to assist in community resiliency planning. While the previous chapter hinted at a methodology that can be scaled up to a national perspective, this chapter lays the foundation for an approach that is simultaneously distinctly local and scaled down.

PREMISE + SETTING

Taking an ecosystem services-based approach, I examine methods of monetizing the ecosystem functions that naturally occur in Kinston's FEMA buyout zone. I analyze two markets that could allow Kinston to generate actual revenue from these ecological processes, and identify the market in compensatory wetland mitigation credits as most appropriate in this context. I propose a schematic framework through which Kinston could maximize its earning potential on this asset by establishing a municipal wetland mitigation bank. While the discussion and analysis is centered on Kinston, the process of ecosystem service monetization could apply to rural communities nationwide.

ECOLOGICAL PROCESS

After the last chapter established how to leverage a community's ecological resources, this chapter describes an effort to also leverage human and cultural resources. I target a community design strategy to those most affected by Kinston's recent experience with flooding and federally subsidized property acquisition, soliciting and receiving qualitative public input on the redesign of Kinston's FEMA buyout zone. I detail the methods used, and summarize the primary findings that will be incorporated into the design proposals. This chapter indicates a path towards achieving rural resiliency that is both highly contextual and place-specific.

COMMUNITY DESIGN PROCESS

This chapter proposes and details design strategies that weave together the ecological and cultural resources of Kinston's FEMA buyout zone. First, using the i-Tree ecosystem service model, I determine a baseline value for the ecosystem services provided on the site. I then iteratively design a space that both quantitatively preserves the buyout zone's baseline creditable ecosystem services, and also functions as a community amenity in ways sensitive to the results of the community design process. I conclude by speculating on the implications of this design process on the future of Kinston, and rural communities nationwide.

SOLUTIONS

EXECUTIVE SUMMARY

Neuse River; Kinston, NC

CONTENTS

1999: flooding from Hurricane Floyd in Edgecombe County, NC (FEMA)

1. IMPERATIVE

In 2012, Hurricane Sandy made landfall in New York City and the nearby urban areas in New Jersey. Ninety mile-per-hour winds and a massive Atlantic Ocean storm surge leveled low-lying areas along the coast and pushed deep into the city's urban core, even reaching the hyper-dense neighborhoods in Lower Manhattan. In response to what would prove to be the second costliest natural disaster in the US since 1900, President Obama promised major federal support to improve the "physical ecological, and economic resiliency of [urban] coastal areas" affected by the storm. Out of this promise came the Rebuild By Design Competition, a US Department of Housing and Urban Development initiative to imagine and manifest regional resiliency in the New York City metro area.

Rebuild By Design may represent the largest federal investment in resiliency in US history. Six international transdisciplinary teams will share $920 million to design and implement infrastructural improvements throughout coastal New York and New Jersey that are massive in physical scale, temporal scope, and international renown. As HUD writes, "'The winning proposals come from teams representing some of the best planning, design, and engineering talent in the world.'"

Outside of the Northeastern US, much of the nation has some familiarity with the impacts of Hurricane Sandy in New York and New Jersey; the public knows about the ravaged shorelines of the Rockaways, Breezy Point, and Atlantic City. And in certain circles, people have that same kind of familiarity with the Rebuild By Design competition; just as the general public knows about the neighborhoods devastated by the hurricane, the general design public knows about BIG's Big U, SCAPE's Living Breakwaters, and

OLIN's Lifelines.

But what both the general mainstream and the design public likely don't know is that, according to the US Department of Energy, Hurricane Sandy left the same percentage of customers without power in urban New York as it did in largely rural West Virginia and New Hampshire (to say nothing of the $3.5 billion in damages and 71 deaths the storm caused in the Caribbean). Voters and designers are likely unfamiliar with rural Vermont's ongoing struggle to recover from Tropical Storm Irene, where 4-8" of rainfall caused nearly every river and stream in the state to flood. The extensiveness and severity of the damage to that state's infrastructure ($700 million to roads and bridges alone) isolated much of Vermont's non-urban population—many without power—for weeks (Figure 1).

And both designers and the public at large are almost definitely unfamiliar with the story of rural Kinston, North Carolina, where unprecedented rainfall from successive hurricanes caused the Neuse River to jump its banks, flooding a poorly sited neighborhood, uprooting a historically close-knit African American population, and challenging a community to plan and design for resilience in a changing climate.

It's neither surprising nor unreasonable that planners, designers, and the mainstream public tend to focus on achieving community resiliency in urban areas, where more infrastructure and more people are exposed to climatic threats like disaster events. Nonetheless, for the millions of Americans who do not live in cities, promoting more resilient planning and design decisions in rural areas remains a critical and under-examined endeavor, one that is literally a question of life or death. What can planners and designers do to achieve a more resilient physical environment in the distant, often isolated communities of the US?

Of course, the answers to these questions will vary from community to rural community. Aside from being not urban, many rural communities in America are very, very different from one another. In addition to often wildly divergent capacities for community planning and economic development, disparities in political climate, and prior exposure to natural disaster events, the geographic dispersal of rural communities nationwide means that they are subject to different forces of nature. Take for instance the two most costly environmental disasters in American history, Hurricanes Katrina and Sandy, both of which had enormous impacts on isolated rural communities. The former reached the gulf coast in August, devastating rural communities like Pearlington, Mississippi (pop: 1,684) and Buras-Triumph, Louisiana (pop: 3,358) with massive flooding and debris hurled by sustained winds of 125 miles per hour. Conversely, when Hurricane Sandy moved on from rural West Virginia, it had dumped 3-5 feet of snow on ill-prepared communities like Alderson (pop: 1,184), Hinton (2,676), and unincorporated Clayton (Figure 2).

In some ways, generalizing about "rural America" might seem like an ineffective (at best) or even simplistic and offensive way of categorizing the thousands of communities and millions of people who meet that criteria. Indeed, as with any effective planning and design intervention, attempts to promote community resiliency in non-urban communities probably should begin and certainly must end with aspects that are both place- and context-specific. Not only should such interventions acknowledge the range of factors that make one rural community different from another; they should celebrate and ***emphasize*** those distinctions as integral to the place-making strategy.

But while it is not my intention to simply paint with the same brush every American who lives outside of a city, I believe that identifying the similarities in the rural condition—in particular, with regards to both the way land is allocated, and the hurdles to implementing planning and design interventions that promote resiliency—is critical for proposing a generalizable framework to prepare rural communities for a changing and uncertain climate. Achieving a model that can apply across various contexts enables communities to benefit from each other's experiences and lessons learned in promoting rural community resiliency. It also enables partners from state and federal government as well as the non-profit sector to target their support; rather than committing a small amount of resources to each of a hodgepodge of rural resiliency strategies, they can concentrate efforts for assisting rural communities into developing and implementing a collective framework.

Accordingly, I submit that despite the host of variations in capacity, climate, and general context that distinguish rural communities from each other, they share at least two qualities: they have a lot of undeveloped land, and relative to cities, not a lot of resources (financial, technical, or otherwise) to do much on it. As will be discussed in the subsequent chapter, these are of course and by no means the only similarities that link the communities that comprise rural America, in particular when it comes to the climate change-related issues that they face. However, extremely general though they may be, I believe that embracing these two themes can help drive the discovery of a commensurately general methodology that transcends the many distinctions that separate communities like Pearlington, Mississippi and Clayton, West Virginia.

Generating value from the glut of undeveloped, ecologically productive acreage that defines rural America can help surmount the insufficiencies in planning and design-related resources that also link these communities. This project uses environmental design model of resource resiliency that, by modifying inputs to correspond to individual rural communities, can meet achieve this generalizable and transcendent task. However, and simultaneously, it proposes a strategy for resiliency that is geared towards one community in eastern North Carolina.

I take an ecosystem services based approach to redesigning nearly 750 acres of publically owned land in Kinston, North Carolina. By leveraging an asset common to all rural communities—lightly or undeveloped land—I examine methods of monetizing the ecosystem functions that naturally occur on the site. After using the i-Tree ecosystem service model to establish a baseline value for the site's current ecosystem service provision, I design a masterplan for the site that both optimizes those ecosystem services and reimagines the site as an amenity for the community. By combining the broader, more generalizable ecosystem services approach with a highly contextual, place-specific community design process, I begin addressing some of the climate-related public health threats particular to rural communities, while also interpreting elements of the site's recent human history. By both scaling up to the regional and national scale and then down to the hyper-local scale, this project seeks to simultaneously operate at planning and landscape architectural scales, blending planning and design to promote ecology, equity, engagement, and ultimately resiliency in a rural context.

Figure 1: critical infrastructure damage from Tropical Storm Irene in rural Vermont (Elizabeth C. Jewell)

Buras-Triumph, LA (EPA)

Figure 2: though rural communities face different climatic threats, it is important to generalize interventions that apply across contexts.

Clayton, WV (Charleston Gazette)

2. PREMISE + SETTING

Rural Kinston, NC
+ the Neuse River

If you live in West Virginia and depend on the power grid, or Vermont and depend on the public roads, or are among the untold millions living in exposed rural communities throughout the US, this is obviously problematic for a variety of reasons. First, the same qualities of population and investment concentration that endanger residents of coastal, riverine, fire-prone, or otherwise vulnerable urban areas also facilitate enhanced recovery from hazard events. Berke and Campanella (2006), for example, note that effective post-disaster recovery planning can enable a community to rebuild with a denser urban fabric. This imperative is worthwhile not only because of densities' broader economic and ecological benefits but precisely because it can make communities "less vulnerable to future disasters."

While cities like New York, New Orleans, and San Francisco expose more humans and their investments to risk by concentrating them within harm's way, those same concentrations also offer redundancies—in infrastructure (such as evacuation routes), physical resources (such as food and water), and outside aid (such as nearby military first responders)—that by definition make urban communities more resilient than rural ones. In contrast, when Tropical Storm Irene washed out US-100, it removed the single route in and out of the towns of Killington (pop: 811), Pittsfield (pop: 546), Granville (pop: 298), Plymouth (pop: 619), Rochester (pop: 1139) and Stockbridge (pop: 736), Vermont. Those towns, along seven others in the state, were inaccessible by car for 19 days (McRea, 2011).

Secondly, the disparity in capacity—be it human (such as amount of specialized staff), material (such as municipal budgets), or otherwise—between urban and rural communities mean that the former are more capable of preparing for future disaster events than the latter. To be sure, simply being more capable of mitigating and adapting to natural hazards does not imply that all urban communities are necessarily safer or more resilient than rural ones. Indeed, as Godschalk et al. (1998) have noted, the nearly 50 largely rural and exurban communities in Missouri that participated in the FEMA buyout program after the 1993 Mississippi River floods were on the forefront of utilizing planning and design solutions to promote a more holistic sense of community resiliency. Additionally, Figure 3 shows several examples of rural communities in coastal Louisiana that have been aggressive about coordinating risk reducing land use and urban design strategies with larger community development goals.

But as Hahn (1970) presciently notes, the general trend is that the kind of anticipatory and farsighted planning and design activities that are necessary to achieve community wide resilience are far from the norm in rural America. For "rural citizens, leaders, and government…acceptance of planning as a local public activity is absent, or half-hearted at best." This would imply that the intricate interdisciplinary professional networks that Lyles (2014; Figure 4) found to promote sound land use policies, disaster mitigation planning, and disaster mitigation plan implementation are less robust in rural communities.

Finally, the entire range of human health-related threats associated with climate change (Chapter 6 discusses the "New Ecological Normal" in greater detail) will not be—indeed, are not currently—distributed evenly across the population. Rather, as Fothergill and Peek (2004), Agrawal (2008), and many others have indicated, socially vulnerable populations will continue to disproportionately suffer from climate-related health threats related to heat exposure, vector-borne disease, and even drought and flooding at a higher rate than the community at large. To be

Figure 3: RISK REDUCTION AND RURAL DEVELOPMENT

Rural and smaller communities in coastal Louisiana are thinking creatively about synchronizing planning and design decisions that reduce risk and promote community vitality.

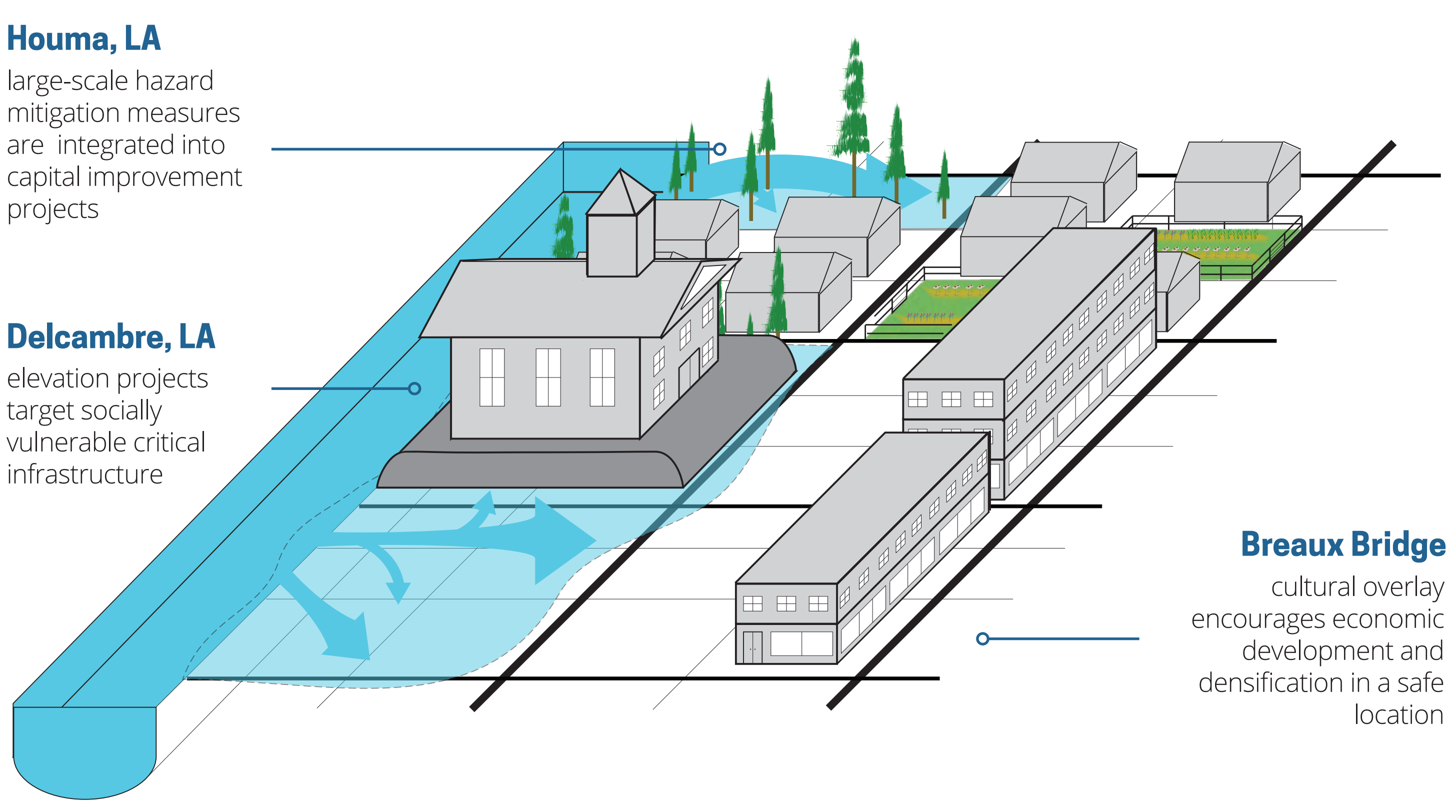
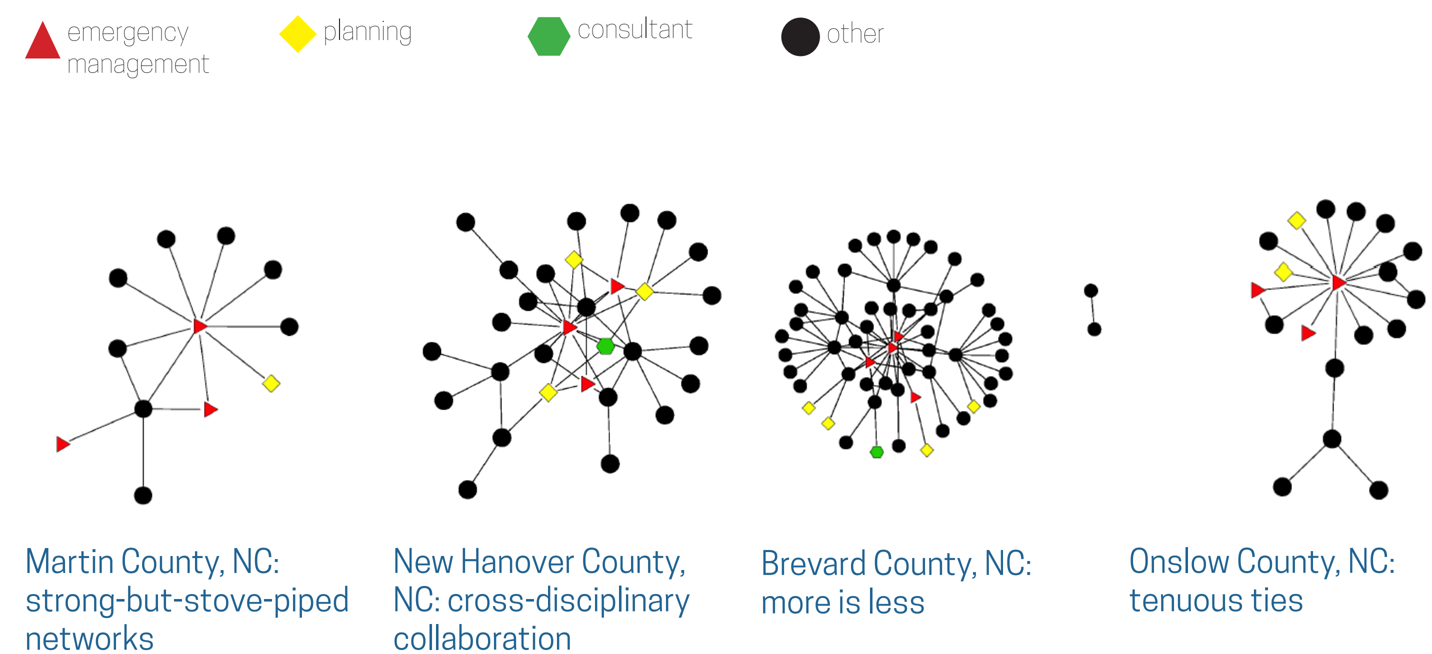


Figure 4: NETWORKS IN HAZARD MITIGATION PLANNING

Using social network analysis, Lyles (2014) found that institutional arrangements that support collaboration can positively influence hazard mitigation implementation. Hahn (1970) implies that these kinds of networks are infrequently found in rural settings.



clear, this is not a distinctly rural problem. For example, Schultz et al. (2002) and Williams and Collins (2001) have documented how the urban heat island effect—a distinctly urban phenomenon whereby dark materials in the built environment create pockets of intense heat—disproportionately affects low-income neighborhoods and communities of color in US inner cities.

However, it is clear that the environmental justice issues raised and exacerbated by climate change, sea level rise, and the global amplifications in extreme weather that can be expected in the future have distinctly rural dimensions, and that certain ecological and human health risks will be more severe for rural communities than urban ones (Figure 5). Jensen (2009) suggests that rural areas in the US are overall more vulnerable to climate change because they tend to have large, disparate proportions of distinctly vulnerable populations, especially seniors, the poor, and those employed in resource-based economies. This last point is important because many who work in climate-sensitive industries, including intensive agriculture, are undocumented migrant workers and thus face additional hurdles of exposure and vulnerability to the health implications of climate change. This is all in addition to the unique and acute vulnerability faced by native and indigenous populations in the US and elsewhere. As Tsosie (2007), Trainor et al. (2007), and many others discuss, both the close ties to the natural world and the physical and political isolation that constitute part of many native and indigenous communities add layers of vulnerability and exposure to this particular segment of the rural demography. These vulnerable rural populations, Jensen (2009) finds, are disproportionately susceptible to climate-related health threats such as higher temperatures, more prolific vector-borne diseases, and drought because of existing disparities in access to health services, emergency services, and employment.

An additional and particularly vexing dimension of inequitable rural exposure to the impacts of climate change is that even effective, well-intentioned adaptations can have negative impacts on rural populations. Lynn et al. (2011) use the examples of urban dam construction and irrigation systems as adaptive projects that may stabilize water supply in urban areas, at the expense of downstream rural communities in the same watershed. Eriksen et al. (2007) also indicate that urban pro-resiliency measures such as new infrastructure can limit rural access to critical water resources.

SETTING

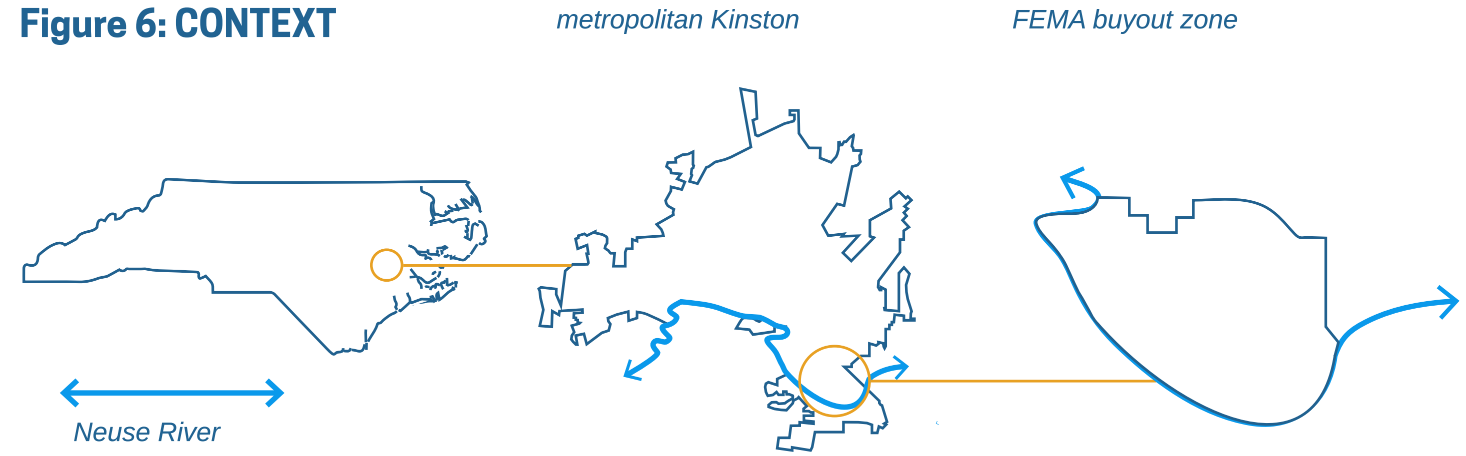
This last equity issue is particularly resonant in Kinston, North Carolina, where some residents still blame the management choices of dam operators in Raleigh for the floods of 1996 and 1999 that devastated much of rural eastern North Carolina. First came Hurricane Fran, which poured 16 inches of rain in four days, flooding most of the Neuse River basin and, in Kinston, causing tens of millions in damages to the already resource-strapped community. In addition to the nearly 400 homes and businesses that sustained damage, critical failures in strategic infrastructure and industrial investments caused incalculable damage to the community's ecological environment, economic function, and human populations. The city's Peachtree Wastewater Treatment Plant flooded, spilling partially treated and raw sewage into the river and city. Similarly, when floodwaters washed through Kinston's six junkyards, they carried with them a host of pollutants as runoff traveled through town and back to the river. And when this deluge combined with overflowing effluent lagoons from the industrial agriculture operations in Lenoir, Greene, and Pitt Counties —many of them concentrated animal feeding operations related to hogs and chickens—they carried a toxic slurry throughout the floodplain, deep into the community, into the river, and out to Pamlico Sound and the Atlantic Ocean (McCann, 2006).

Though devastating, the horrific aftermath of Hurricane Fran was also an opportunity—what Birkland (1997) refers to as a window to reimagine and remake a community's risks, dysfunctions, and inequities. But as Berke and Campanella (2006) note, "windows typically do not stay open for long after a disaster," and in Kinston's case post-Fran, the window closed with virtually nothing tangibly done to prepare for subsequent disaster events. So, when Hurricane Floyd struck Kinston in 1999, it found a built environment and land use pattern virtually unchanged since 1996. But rather than simply repeat the destruction of the previous storm, Hurricane Floyd actually augmented it, dumping nearly the same amount of rain (13", compared to Fran's 16") but in a much shorter amount of time (24 hours, compared to Fran's 96-hour rain interval). Additionally, Hurricane Floyd was presaged by Hurricane Dennis, which had saturated the Neuse River basin with heavy rainfall two weeks before. Unable to absorb rains of two successive storm events, the watershed poured runoff into the river, which

Figure 5: RURAL CLIMATE CHANGE IMPACTS

While the impacts of climate change are currently and will continue to threaten the ecological and social order of human communities worldwide, there are also threats to public health, economic vitality, and community viability that are specific to certain kinds of communities. Based on a variety of distinctive demographic and cultural factors, these impacts are anticipated to be uniquely profound in rural communities.

Figure 6: CONTEXT



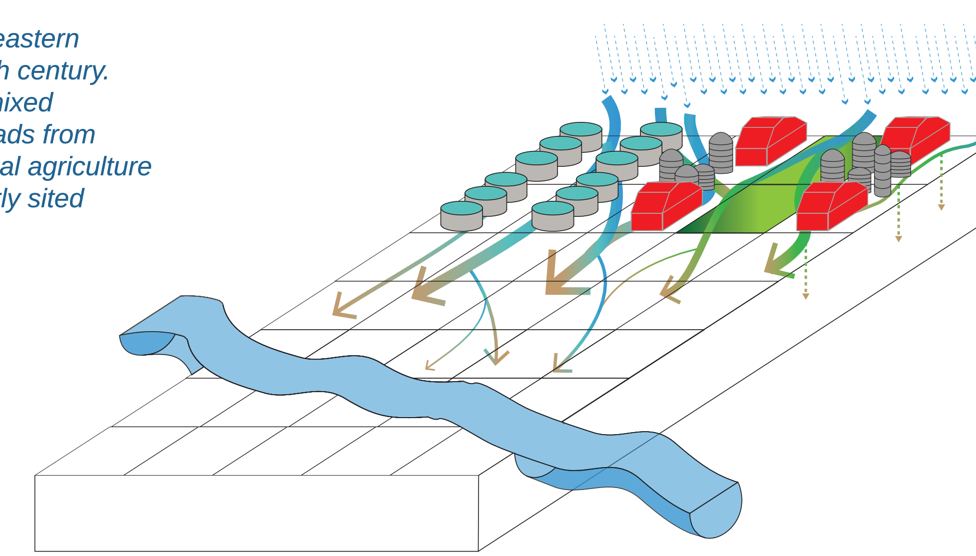
crested to a height of 38.8'—10' above flood stage. According to the Federal Emergency Management Agency, the intensified flooding precipitated by Hurricane Floyd caused substantial damage to over 700 homes and 200 businesses, left over 20,000 residents without power, and necessitated the emergency rescue by National Guard troops of hundreds of Kinston residents. And again, the Peachtree Wastewater Treatment Plant flooded (Figure 7).

FEMA ACQUISITION PROGRAM

But rather than make the same mistakes again, Kinston was able to take advantage of its window, harnessing the momentum of the unified community sentiment post-Floyd to participate in the Federal Emergency Management Agency Property Acquisition Program (the "FEMA Buyouts") at an exemplary scale. Through the Hazard Mitigation Grant Program (HMGP), FEMA supports hazard mitigation and recovery actions at the local level. Among helping fund projects like stronger emergency command centers, elevated structures, or safer public utilities, FEMA also offers funding—up to 75% of the total cost—to help communities purchase properties that have been severely damaged or destroyed by disaster events. Under the terms of a FEMA buyout, homeowners can receive the pre-storm market value of their house and property, and are under no obligation whatsoever to accept the purchase offer from the local government. They are also free from having to pay closing costs, title searches, appraisals, surveys, or any other transaction costs associated with the acquisition. Should property owners consent to sell

Figure 7: Hurricanes Fran (1996) and Floyd (1999)

Successive hurricanes devastated eastern North Carolina at the end of the 20th century. In Kinston, deluges of stormwater mixed toxic waste and massive nutrient loads from industrial agriculture nearby industrial agriculture operations with pollutants from poorly sited wastewater treatment plants.



their property, they transfer title to their land and home/business (or whatever is left of it) to the local government (either a city, a county, or in Kinston's case, both), who then is required to abide by strict requirements regarding how the purchased land can be used in the future. Specifically, the statute that enables the HMGP states that land acquired with federal funds:

...shall be used only for purposes compatible with open space, recreational, or wetlands management practices; in general, such uses include parks for outdoor recreational activities, nature reserves, unimproved pervious parking lots...

Furthermore, these conditions apply "in perpetuity." While these terms may seem severe and difficult for communities to abide by, consider this: since the penalty for violating these terms is that communities have to return to FEMA the federal portion of the funding used for property acquisition, a figure that frequently eclipses $100 million, a community has never defaulted on its HMGP promise.

Herein lies the benefit of property acquisition as a municipal tool for hazard mitigation. Unlike other common planning and policy strategies like flood insurance, building regulations, or physical flood control measures, the act of acquiring and then holding as forever undevelopable the most vulnerable and flood-prone areas of a community's landscape permanently ensures that future development, investment, and human habitation will not be in harm's way. Additionally, it enables victims of environmental disasters to receive substantially more financial compensation for their losses than they likely otherwise would have. When paired with other progressive municipal policies (Kinston linked the buyout to other community goals, using the post-Floyd momentum to: create affordable housing near the downtown core, much of which was rented to those who lost their homes in the flooding; decommission the troublesome wastewater treatment plant and five of the six offending junkyards; and create a downtown business incubator), acquisition can simultaneously preserve a community's tax base while achieving other community co-benefits. And finally, as we shall see, the strict regulatory framework that the FEMA buyouts impose on federally condemned land can actually serve as an opportunity to generate revenue for the community through monetizing the provision of wetland ecosystem services.

As McCann (2006) has noted, Kinston's post-Floyd participation in the FEMA buyout program was nothing short of incredible. Despite significant limitations in resources, a high concentration of highly socially vulnerable populations, and a generally stagnant local economy, the city and Lenoir County were able to facilitate the migration of over 90% of those living in its 100-year floodplain. Of those Kinstonians eligible to receive HMGP buyout money, 97% participated, totaling nearly 775 acquisitions and between 1500-2000 individuals (McCann, 2006).

The demographics of Kinston's FEMA buyout underscore the inequitable distribution of vulnerability to ecological hazards and the impacts of anthropogenic climate change. Given the mountains of research that documents the many ways in which those least able to respond to dramatic changes in the environment are also those most exposed to them, it should come as no surprise to learn that the segments of the Kinston community who lost the most during Hurricanes Fran and Floyd were less wealthy, less well educated, and more African American than the community overall (Figure 8).

In addition to being the Kinston FEMA buyout zone and "Lenoir County, North Carolina Census Tract 103," this area was (and still is) known to residents as Lincoln City, an historic, culturally vibrant African American community. This neighborhood was marooned to the marginal low-lying lands south of high ground and the mostly white downtown where, as will be discussed in further detail in Chapter 4, it facilitated close connections between its residents and their place. To be sure, many residents welcomed the post-Floyd buyout—the 97% participation rate is a testament to that. But in addition to providing an opportunity to start anew in safer, less hazardous locations, the buyout also fragmented a once close-knit community. As former Lincoln City residents moved throughout the county, state, and indeed the nation, next door neighbors became estranged from one another, and what was once a neighborhood became a diaspora.

More than the often obscured long-term financial concerns associated with property acquisition programs, the psychological toll from the fragmentation of a neighborhood is among the most lingering and problematic consequences of Kinston's buyout. As McCann notes, Kinston prudently mitigated some of the negative externalities that are often associated with property acquisition. For example, the city linked the buyout to other community goals, using the post-Floyd momentum to create affordable housing near the downtown core, much of which was rented to those who lost their homes in the flooding.

But while it is true that some of the unintentional victims of the buyouts were able to relocate nearby their former neighborhood, many could not secure sufficient housing within the city limits. Others still were likely unwilling to remain in Kinston after witnessing and indeed experiencing an event as traumatic as the destruction of one's figurative and literal home and sense of place. As Solnit (2010) notes in her analysis of the communities that arise from the rubble of different environmental and social disasters from around the world, survivors are often incapable of returning to their homes after these often violent and traumatic kinds of events. Perhaps those displaced by the floods and buyouts in Kinston could anticipate the eerie and unsettling character that their former neighborhood would soon adopt (Figure 9), and decided to move away rather than deal with the grief.

In any event, the displacement of this less wealthy, less well educated, overwhelmingly African American community adds a layer to the tenor of and imperative for redesigning Kinston's FEMA buyout zone. Psychiatrist Dr. Mindy Fullilove refers to the emotional toll that accompanies this type of displacement as root shock, "the traumatic stress reaction to the loss of some or all of one's emotional ecosystem (Fullilove, 2005)." Though initially applied to the sense of upheaval and alienation experienced by New York residents displaced by gentrification during the urban renewal era, the concept was later applied to refuges from other massive ecological and cultural shifts, such as environmental disasters. While it is crucial for the design process to tackle the significant, uncertain, and mounting ecological issues that the site faces over the coming decades, it is also important to address this psychological toll that can often accompany well-meaning and generally effective hazard mitigation techniques like property acquisition.

Figure 8: DEMOGRAPHIC DISPARITIES IN KINSTON'S FEMA BUYOUT (2000)

While Hurricanes Fran and Floyd likely exacerbated citywide issues of poverty and lack or education that pre-dated both storms, the flooding and subsequent buyouts from those environmental disasters had a disproportionate impact on some of the community's most socially vulnerable. And as has been the case in countless other instances throughout the world, those most exposed to environmental and social calamaties like those in Kinston represented a citywide minority racial group.

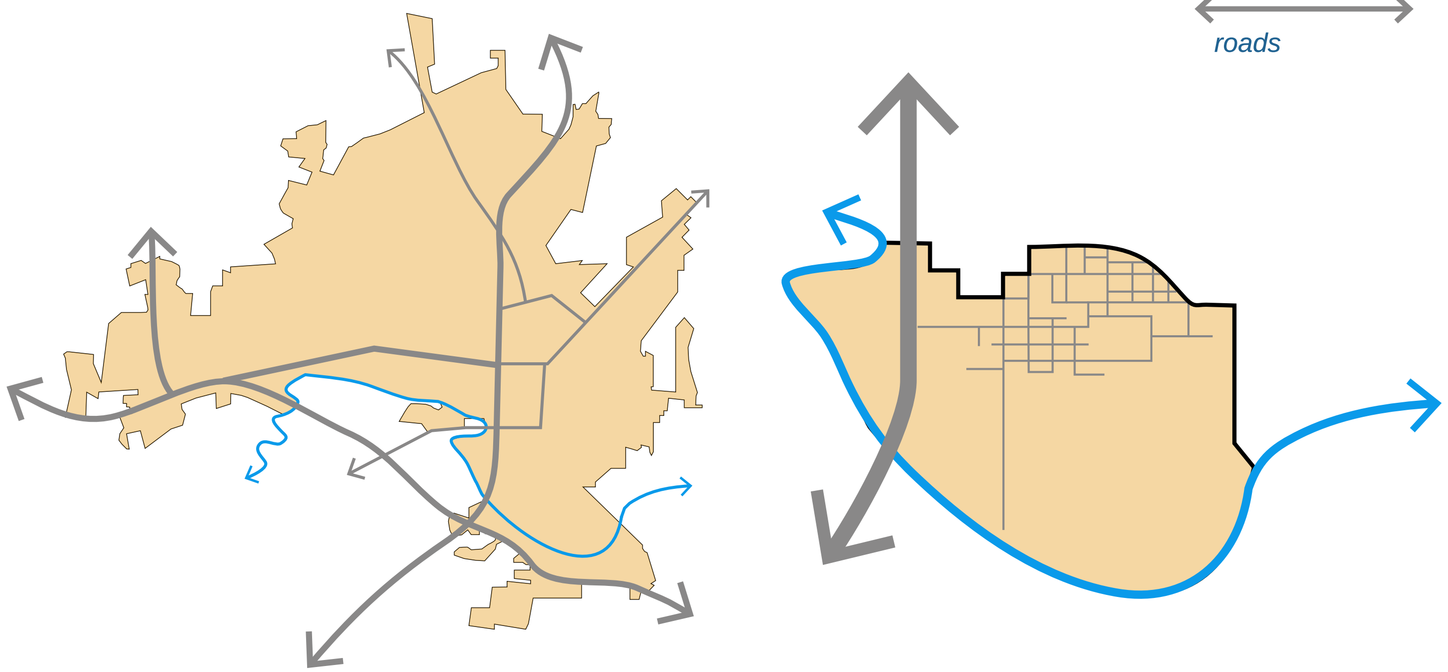
all data from the 2000 Census

City of Kinston

total population: 23,819

FEMA buyout zone

total population: 2,339



	City of Kinston	FEMA buyout zone
% African-American	62.64%	97.78%
median household income	$26,630	$10,252
% 25+ without HS	31.34%	50.51%

Figure 9: Devastated by the flooding from hurricanes Fran and FLoyd, Lincoln City was then vacated by the FEMA buyouts. While the acquisition program saves resources and lives, it nonetheless fragmented this vibrant Africaan American neighborhood, vestiges of which can still be seen today.

3. ECOLOGICAL PROCESS

With scant public resources to mobilize resiliency-advancing projects that mitigate natural hazards and adapt to profound shifts in ecology, it makes sense to target efforts for resiliency where human and infrastructural vulnerability is most concentrated. By definition, rural communities—sparsely populated and with little built infrastructure—lack the kind of agglomerations that make these kinds of investments effective or feasible. But while development patterns in rural America make it harder to justify huge expenditures for investments like levees and living shore lines, they also offer opportunities to generate revenue needed to promote community resiliency. Recent advances in valuation modeling and geospatial analysis make it possible to financially account for the value of ecosystem services, the umbrella term applied to the range of benefits that accrue to humans from naturally occurring ecosystem functions (Brown et al, 2007). This anthropocentric framework chooses to sidestep analysis of or speculation about any intrinsic or innate value embedded in "nature" (the ecological networks that exist outside of humanity), viewing the non-human world strictly in terms of its economic relationship to humans: what, in other words, are the world we occupy and the services it provides worth?

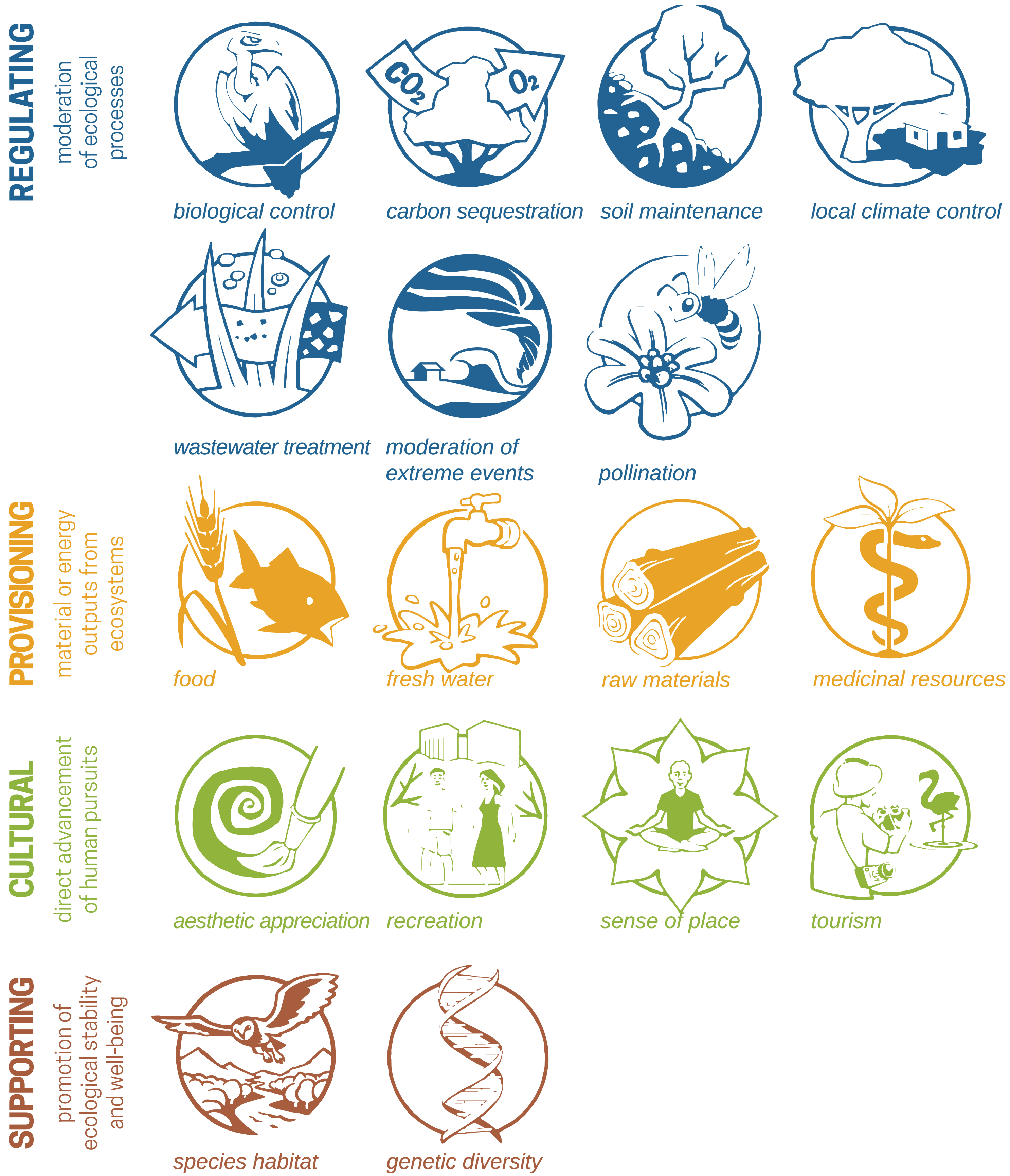
NATURAL CAPITAL

Accurately valuing ecosystem services can have a significant impact on growth management . Hawken et al (1999) argue that though it relies on the stability and quality of natural capital, "the stock of natural ecosystems that yields a flow of valuable ecosystem goods or services into the future," (Costanza, 1997) industrial capitalism

Figure 10: ECOSYSTEM SERVICES

By passively and efficiently producing virtually limitless goods and services, healthy ecosystems provide essential services at a fraction of what it would cost to synthesize them. The Economics of Ecosystems and Biodiversity (TEEB) parses the range of ecosystem services into four general categories.

icons by Jan Sasse for TEEB



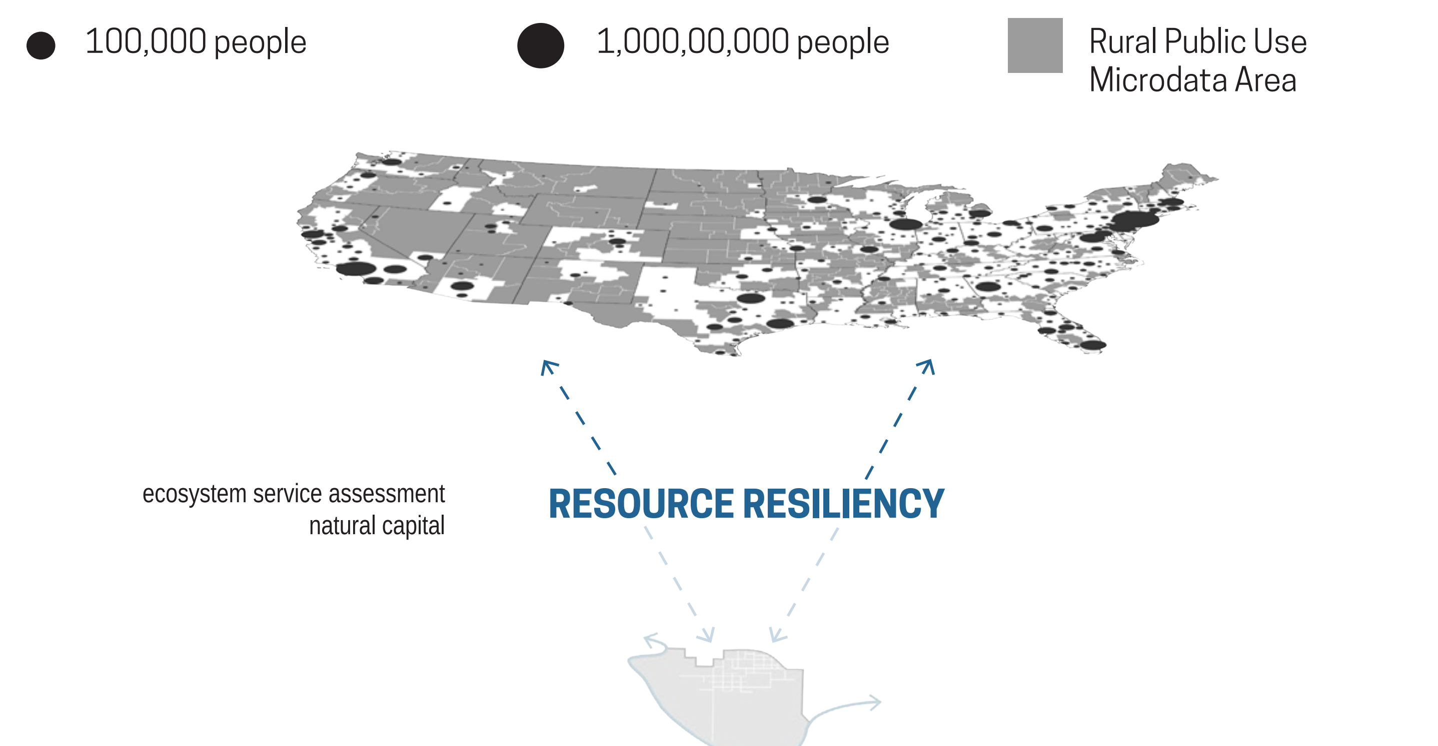
does not accurately account for or value these inputs. As a result, capitalist societies unsustainably consume natural capital. A more accurate understanding of the inextricable role that rivers, forests, and other elements of the biosphere play in the global economy would facilitate profound shifts in the ways that humans behave towards these assets.

A rigorous inventory of the virtually limitless ways that humans—with little or even no cost to us—benefit from the ecological processes that comprise our world is well out of the scope of this project. However, it is important to note that researchers typically divide ecosystem services among four categories (Figure 10). Regulating ecosystem services help control other ecological processes, either increasing those that we benefit from or limiting those that we do not. Provisioning ecosystem services are those whose outputs can serve as material goods for human society. Similarly, cultural ecosystem services are those that nurture the non-material dimensions of the human experience. Lastly, while we may not directly derive benefits from these services, supporting functions contribute to the overall stability of the biosphere and ensure the longevity of the other ecosystem services.

A more comprehensive understanding of ecosystem service value could change the ways that planners determine land use and evaluate development choices. The literature is full of research that explores the relationships between ecosystem service modeling and land use and environmental planning. For example, team members at the Natural Capital Project, responsible for development of the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) modeling suite, have published 12 articles that explicitly describe methods of linking InVEST to land use planning. Keep in mind that this list only includes research conducted 1) by Natural Capital Project researchers 2) using this one ecosystem service model (several prominent models exist, including ARIES, and, as will be discussed in further detail later, i-Tree). While these kinds of applications occur evaluate a range of different ecosystem services—from tourism to food production to nutrient retention—and occur in various development and ecological settings around the

Figure 11: SCALING UP

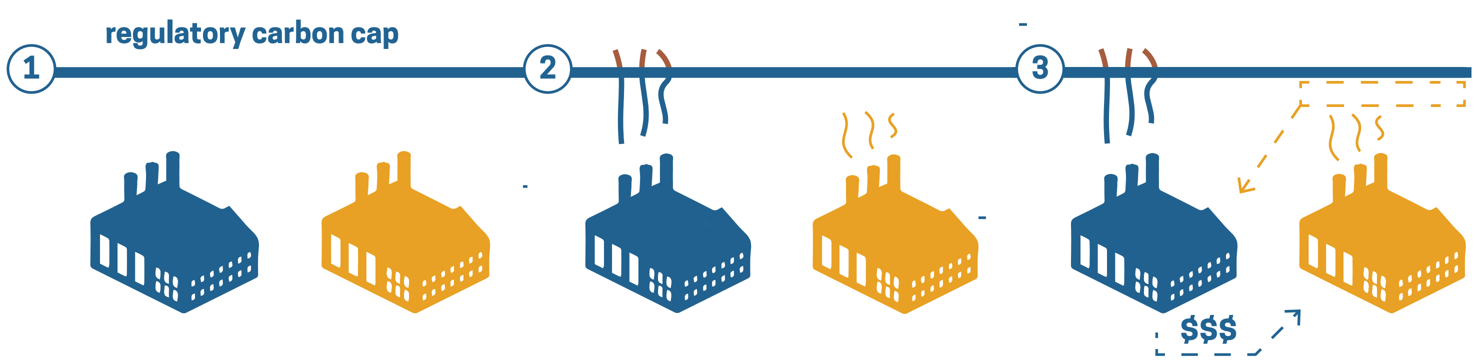
With minor adjustments for ecological and cultural context, the frameworks and techniques used in this project can be applied to rural communities throughout the US.



data from Choices Magazine

Figure 12: CARBON CREDITING

Carbon cap-and-trade programs create markets for the right to pollute. Regulators assign a limit to the amount of greenhouse gases that polluters can emit, and require excessive polluters to either pay steep fines or purchase credits from other emitters that have not met their cap. This regulatory market incentivizes efficient emission practices.



Individual polluters are given an annual cap on the amount of certain greenhouse gases that they are permitted to emit. Caps are calculated and often customized depending on a variety of factors, depending on the regulatory regime.

Regulators determine that a polluter has emitted more greenhouse gases than they are permitted.

The offending polluter is allowed to purchase the ability to exceed their limit from a polluter that has emitted below their regulatory cap. The additional cost to the offender, and the corresponding profit to a competitor, disincentivizes inefficient emission control.

globe—from urbanizing Hawaii to rural Chile—each is fundamentally driven by the same methodology: using ecosystem service modeling to determine prices for a parcel's ecosystem service provision, then comparing the benefits of the same parcel in a largely undeveloped state to those of it under more intensive development.

As will be developed further in subsequent chapters, this method of using ecosystem service modeling to compare planning and design scenarios is one of the primary ways that this project can be scaled up and applied to rural communities nationwide (Figure 11). While the types and methods of ecosystem service provision will vary from community to rural community, this approach can be applicable in a range of contexts throughout the US.

DIRECT MARKET VALUATION: CARBON CREDITING

There are several methods for attributing prices to natural capital. One common technique is to consider the social costs that ecosystem function helps communities avoid; in other words, what would it cost our society if these services were simply to go away? Commonly, environmental economists apply this valuation method to climate regulation to measure the value of a carbon sink's contributions to, say, maintaining a productive agricultural landscape. A similar ecosystem service valuation method assesses the real-world costs of replacing or fabricating natural ecosystem service function. This technique is commonly applied to a landscape's nutrient retention value. In this case, ecosystem service models quantify the price of replicating natural water treatment processes through chemical or industrial water treatment techniques.
While the social costs of carbon and the avoided costs of wetland productivity are both quantifiable and real, they may not stand up to the scrutiny of an already skeptical public. In particular, though the general scientific consensus around anthropogenic climate change is increasingly permeating into mainstream discourse, many in this country, including 169 members of the 114th Congress, deny that humans are responsible for the profound ecological transformations that we confront in the present and future. This segment of the population is not likely to be swayed by figures for economic value expressed in terms of avoided or social costs.

Additionally, even if stakeholders and decision makers in communities like Kinston embrace the validity of this kind of environmental economics, there is little incentive or, importantly, opportunity to incorporate this information into local level planning and design decisionmaking. Regardless of their position on climate science, cash-strapped and low-resource communities need funding and staff to achieve social resilience; not sound economic reasoning.

For these communities, a more pragmatic method for valuating ecosystem service function is to determine an ecosystem's market value—how much would this good sell for? For some ecosystem services, most notably carbon storage and sequestration, direct market valuation both eminently possible and increasingly common.
In particular, the private sector offers various place-specific methodologies for evaluating and quantifying a given parcel's capacity to sequester and store carbon, and then determining what that capacity would trade for in markets that deal in carbon credits.

These markets come in two varieties: mandatory and voluntary. Of the two, the voluntary markets trade in the smaller volume of credits. With no regulatory instrument to drive up demand for credits in these markets, there is less demand for and value in credits traded in voluntary markets than those traded in mandatory or compliance-driven markets. These carbon markets emerged out of the 1997 Kyoto Protocol, an international treaty which established a "cap-and-trade" system to limit greenhouse gas emissions worldwide. Under this arrangement, nations that are party to the treaty commit to reducing their overall greenhouse gas emission by an average of 5.2% below their 1990 baseline between 2008 and 2012. If ratifying nations are not able to meet these targets ("caps" on greenhouse gas emissions) by reducing their own emissions, then they must either deal in emissions allowances with other countries that are below their own cap, or purchase carbon credits from elsewhere ("trading" in carbon offsets; Figure 12). A credit is one metric ton of atmospheric carbon dioxide. Through the Kyoto Protocol, the ratifying nations that are in the European Union have created a "bubble" that enables the 15 original member states of the EU to operate as a single entity for compliance purposes. Under the EU Emissions Trading Scheme, they have a shared cap, and are empowered to make collective trading decisions, resulting in the largest mandatory cap-and-trade scheme to date (Stockholm Environment Institute, 2015).

There are also several cap-and-trade compliance schemes that operate independently of the Kyoto Control. In addition to the New South Wales Greenhouse Gas Reduction Scheme and the Western Climate Initiative, the state of California debuted its own cap-and-trade program in early 2012. The California Air Resources Board (CARB) Compliance Offset Program is a large, sprawling cap-and-trade scheme that along with a similar program in Quebec, accounts for the bulk of the carbon market in North America. Just like the scheme enabled by the Kyoto Protocol, greenhouse gas emitters—in this case, businesses operating in California—either purchase a credit (the permission to emit a ton of atmospheric carbon dioxide) from a decreasing number of state-issued credits, or they purchase carbon offsets which do not necessarily have to be generated in California.

In 1990, the same CARB terrified the auto and oil industries by issuing a mandate to require the nation's seven largest automobile manufacturers to offer electric vehicles in that state—the so-called zero-emission vehicle mandate. Though the CARB ultimately eviscerated the mandate in 2003, it had the potential to fundamentally remake the nation's fleet of small cars and trucks. While car makers like General Motors and Toyota would have still been allowed to produce and sell combustion engine automobiles elsewhere in the US, the technological challenge of producing one set of cars to sell in California and one set to sell in the other 49 states would have been so significant as to force the nation's auto makers into a perplexing choice: either stop selling cars in California, or sell more electric cars nationwide. In this way, the CARB would have been able to indirectly influence an entire market with one state-level decision.

This same story can be told with carbon offsets. While many standards exist to certify and define a “carbon offset,” the California one likely trumps them all. Because of the scale and profitability of the trade in offsets on the California carbon market, that state can define the function and form of the ecosystem service restoration projects that are designed to generate them. In other words, if a restoration project wants to generate real revenue, then it better ensure that it generates credits that can be sold to polluters in California. Fortunately, the differences between the CARB standard and a different established set of criteria such as, say, the Gold Standard offset market are minute enough to reach some broad conclusions about project eligibility and design. While carbon credit syndicators and project managers like Tierra Resources and Green Assets (covered below) will need to understand the subtle distinctions between credit eligibility, it is appropriate for my purposes to identify the similarities across the different markets, which the California statute succinctly encapsulates. In California, any offset purchased by a greenhouse gas emitter subject to the CARB cap-and-trade scheme be “real, permanent, quantifiable, verifiable, enforceable, and additional” (California Health and Safety Code). The first five criteria are relatively self-explanatory: the project has to be designed in such a way that its impact can be continuously monitored by a licensed third-party approver. However, the final criteria—additionality—has proved to be the most contentious in the monetization of carbon credits worldwide, and is a potentially prohibitive issue in the case of Kinston, NC.

In terms of the carbon market, a project passes the additionality test if the reductions it achieves would not have happened without the project. If, in other words, a project would have occurred without the promise of revenue generated through carbon markets, then it is not eligible to be sold in California’s compliance market or any of the emergent voluntary markets. (This doesn’t mean that credits generated by non-additional projects are never sold on voluntary markets. On the contrary, voluntary markets have been criticized for being insufficiently unregulated and thus permitting trade in credits from projects that appear likely to have happened anyway. See Haya 200s8.) On its face, this makes sense—rather than simply issuing prizes for the status quo, the purpose of a cap-and-trade scheme is to incentivize new reduction and sequestration of greenhouse gases. The concept is nonetheless highly problematic because there is way to systematically evaluate whether a project passes the test. According to the Stockholm Environment Institute, “[t]he key difficulty lies in the need to compare the projects’ actual emissions to a counterfactual scenario reflecting another reality, one in which the activity is not implemented as an offset project.”

For rural communities, this method of ecosystem service valuation could be a powerful tool for achieving resilience and other community co-benefits. First, by promoting conservation of sensitive ecosystems like tidal wetlands and forested swamps marketing ecosystem services promotes density, effectively encouraging development on higher ground by discouraging it in unsafe locations. In this way, a community that uses a market-based ecosystem service valuation method and then takes its ecosystem services to market is participating in its own version of a FEMA buyout. A critical difference between the two practices, however, and the second major boon of market-based approaches to ecosystem service valuation, is that this method enables rural communities to generate real revenue from that which, by definition, the have a lot of: their undeveloped land. One of the strengths of direct market-based ecosystem service valuation is that, unlike some of the valuation methods discussed later, it isn’t abstract or academic; the entire premise is to determine how much the ecosystem service would actually sell for. While there are still transactional costs and administrative hurdles for communities to make the leap from simply valuing ecosystem services for what they would be worth to actually selling them on a global market, this method facilitates precisely that leap. If the revenue from such a transaction is then leveraged to provide a community resource that, say, mitigates the spread of vector borne disease or helps residents live with hotter summer days, then this method of viewing and operationalizing natural capital can be a tremendous resource for rural communities seeking enhanced resilience to climate issues. North Carolina is increasingly receiving attention from private-sector market-based ecosystem service conservationists. New Orleans-based Tierra Resources, a kind of syndicator of carbon offset credits, has developed a modular method for ecosystem function evaluation that is tailored towards gulf coast carbon storage and sequestration in wetlands ecosystems (“blue carbon”).

Working with landowners who are interested in receiving carbon credits for wetland restoration projects undertaken on their land, Tierra Resources first conducts a feasibility study to determine the eligibility and viability of market-driven restoration on a particular parcel. In addition to the eligibility factors discussed above, a variety of factors determine a project’s viability, including the amount of land involved, the types of land cover, and the climatic conditions of a parcel, such as its average annual precipitation. If a project is eligible and feasible, the landowner commits to a 40-year restoration project, during which she or he may not “participate in activities that will damage the restored wetlands.” While landowners may fish, hunt, and pursue the mineral rights on their property during the 40-year restoration period, they may not harvest timber on the parcel.

Once a landowner accepts these terms, Tierra Resources then leads him or her down the long, winding road to developing and marketing the eligible carbon credits: they implement the wetland restoration practices, continuously monitor the carbon sequestration, ensure that the activities receive the necessary third-party verification, and trade the verified credits on a carbon exchange. The sale of these credits then covers the cost of the project’s development, after Tierra Resources recoups their fee. Though to date, Tierra Resources model only applies to restoration projects in gulf coast wetlands, founder Dr. Sarah Mack (personal conversation) is currently working to adapt the model to other ecosystems, including wetlands in North Carolina. And while Tierra Resources is one of the most successful syndicators of carbon offset credits, they are by no means the only. For example, Wilmington-based Green Assets provides a similar service to landowners looking to fund forest restoration projects.

ELIGIBILITY IN KINSTON

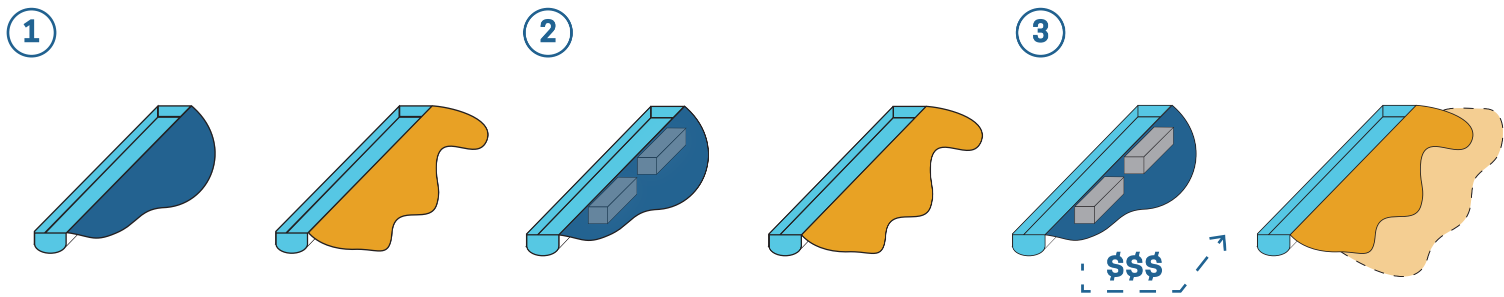
This valuation method and the resource monetization that it facilitates has the potential to promote safer land use patterns and generate revenue for resiliency-minded rural communities in North Carolina and elsewhere. However, direct market valuation is not currently recommended in Kinston’s FEMA buyout zone because the ecosystem services contained therein are effectively unable to be monetized.

There are two reasons for this. First, as discussed in Chapter Two, the terms of the FEMA buyout render the buyout zone effectively undevelopable—i.e., preserving Kinston’s floodplain as carbon-sequestering riparian forest and wetland does not provide any additional greenhouse gas reduction. Environmental economists refer to this concept as “avoided conversion” of forests to non-forests use (L&C Carbon, 2015). The statutory regulations that essentially preclude intensive development within the buyout zone mean that the carbon storage/sequestration capacity of the forest there is not —and indeed cannot be—threatened by development. Since an ecological conservation or enhancement project on the site would not be helping to avoid the potential loss of the forest and its ecosystem services, such a project would not pass the standard for additionality that the carbon offset markets require.

In assessing the ecosystem service value of Wake County’s publicly managed open space, Schmidt (2012) seeks to sidestep the question of additionality by arguing that, though publicly managed and preserved, these open spaces can still be developed in ways that decrease their value as ecosystem service purveyors. She argues that the properties in her study “can be converted to ball fields, basketball courts, and other more ac-

Figure 13: WETLAND BANKING

Like a carbon cap-and-trade system (Figure 12), compensatory wetland markets require the perpetrator of some environmental degradation—in this case, the development of a wetland—to financially mitigate their actions. The revenue generated through wetland mitigation can be used to manage and expand pristine wetlands elsewhere.



Two different wetland areas, often spatially distant but generally part of the same watershed, sit undeveloped.

A public or private developer plans to build in one of the wetland areas, fundamentally changing the wetland ecology and causing a loss of ecosystem services in that wetland.

Development is allowed to proceed when the developer either purchases wetland mitigation credits that are produced offsite, or pays a commensurate fee. The income from this transaction is used to enhance wetlands elsewhere.

tive recreational purposes, which would arguably degrade the ecological quality and accompanying ecosystem benefits that would come with putting in hard infrastructure with such activities," making those ecosystem benefits vulnerable and thus quantifiable.

I accept this premise, and I believe that it justifies conceiving of the ecosystem benefits generated in Kinston's floodplain as actual ecosystem services. However, it does not appear that this standard is sufficiently robust for a restoration or conservation project on this site to pass the stricter additionality standards needed to qualify credits generated here for sale on either the voluntary or mandatory carbon offset markets.

But even if this project were to pass the additionality test and generate market-eligible offset credits, Kinston's floodplain and FEMA buyout zone would still be an ineffective source of those credits because of its size. While Schmidt's findings are specific to Wake County's Piedmont landscape, the rigorous geospatial analysis techniques used and Kinston's proximity to Wake County make those findings appropriate proxies for estimating the carbon sequestration and storage value of the FEMA buyout zone.

Assuming a social cost of carbon (SCC) of $60/ton, Schmidt suggests that the annual carbon sequestration and storage value of the FEMA buyout zone in Kinston might be worth $185,436. However, this SCC is significantly higher than other assumptions. In 2015, for example, the EPA released its own figures for SCC, recommending $37/ton. Pro-rating Schmidt's findings with this SCC would reduce the annual carbon sequestration and storage value to $114, 352. And again, this would be the annual value from a social, rather than market perspective. Given that the notion of a social cost is designed to offset a market's inability to accurately price ecosystem services like carbon sequestration, we can expect the actual market value to be even lower than these social cost findings. Finally,

once transactional costs are factored into the sale price, that figure dips even lower, leaving an unknown but surely paltry profit (if any) for Kinston and Lenoir County to invest in other pro-resilience measures. The unlikelihood of being able to monetize the ecosystem services housed there, and the likelihood of any potential future profit being negligible, make a direct market-based method a dubious one for valuing the ecosystem services in Kinston's FEMA buyout zone.

DIRECT MARKET VALUATION: WETLAND BANKING

While carbon crediting is likely not a viable source of ecosystem-related revenue generation for Kinston' buyout zone, there are other direct market valuation avenues the community might pursue to monetize its floodplain ecosystem services. Just as different international and state-level regulations have created markets in carbon sequestration and storage capacity, two regulatory federal programs have created markets in wetland restoration and maintenance. While the first, the Food Security Act, does drive some generation of wetland credits in the US, most of the wetland mitigation economy is a response to Section 404 of the Clean Water Act of 1977. Under the federal regulation, development that is anticipated to negatively affect aquatic ecosystems like wetlands must apply for and receive a permit from the Army Corps of Engineers, who determine if and how such a project can be implemented. In order to receive a permit to develop in or near aquatic ecosystems, projects must avoid impacts to the aquatic landscape, minimize unavoidable impacts of the proposed development, and/or provide compensation for unavoidable impacts through a process called wetland mitigation (Figure 13).

Just as the carbon cap-and-trade system seeks to promote ecological carbon storage and sequestration by requiring polluters to offset their excess emissions, the permitting regime under the Clean Water Act seeks to incentivize the restoration of aquatic ecosystems through compensation. By requiring developers to mitigate their impact on aquatic ecosystems, the program attempts to either curb harmful development in sensitive landscapes, or at least generate revenue to pay to improve similar landscapes elsewhere—the notion of "no net loss" of aquatic ecosystem resources recommended in the late 1980's. And indeed, just as private third parties like Tierra Resources and Green Assets use proprietary geospatial assessment methodologies to strategically acquire parcels that can generate carbon storage and sequestration credits, mitigators like Earth Balance (FL), New Forests (IN), and GreenVest US (NC) have sprung up to meet demand for Clean Water Act permits through mitigation banks. These for-profit entities acquire and restore degraded aquatic ecosystems, often amassing them into large spatial units called "mitigation banks," which harness economies of scale to produce large amounts of mitigation credits in one area (BenDor and Brozovic, 2008). In North Carolina, even more successful than private mitigation banking has been the state-run Ecosystem Enhancement Program (EEP), which emerged to meet NCDOT's outsized need for mitigation credits to satisfy federal requirements to offset infrastructure development. Though initially intended for public agency use, credits generated through this state program were eventually marketed to private developers, and at a discount: one study found that fees collected by EEP crediting were $10/linear foot of restored stream less than the inflation adjusted expenses of the restoration activities (Templeton et al, 2008). Due to this competitive advantage, credits generated through the EEP are the primary wetland mitigation currency in North Carolina.

Can this kind of wetland crediting benefit Kinston? From a regulatory standpoint, yes; unlike its carbon storage and sequestration capacity, Kinston's FEMA buyout zone is eligible to generate credits through the EEP (or any other private mitigation banking program). And according to some estimates, these kinds of credits could be highly lucrative. Though the Army Corps of Engineers does not make publically available the sale prices of Section 404 mitigation credits, it is possible to use in-lieu fee prices (what a polluter would pay in cash, rather than in wetland restoration, to mitigate development) as a proxy for the market value of wetland mitigation credits.

While there is a great deal of national and local variability in these prices, depending on factors such as imbalances in credit availability relative to development pressure, the EPA (2008) estimates that in North Carolina, riparian wetlands like those in Kinston are worth $36,000-$63,000 per acre of restored wetland (Ecosystem Marketplace, 2015). Multiplying the middle of this range by the acreage of the buyout zone yields a value of nearly $37 million that can be used for restoration activities. It should be noted that the EEP rate for North Carolina riparian wetland--$63,414/acre—is at the upper bounds of the EPA estimate and would therefore produce an even higher yield in ecosystem service-generated revenue (Karl, 2010).

Several significant caveats apply to this estimate. First, not all of the buyout zone is riparian wetland; moving north from the river, the ecology transitions to non-riparian wetland, which the EPA estimates as less valuable than riparian wetland. Additionally, this estimate does not factor in the transaction costs of certifying, monitoring, and marketing the mitigation credits generated by the restoration activities. Finally, this estimate does not account for the time value of the credits, which are generated over a period of time and not all at once. Nonetheless, this still appears to be a potentially substantial source of revenue for the community.

However, setting aside the financial aspects of these potential credits, there is a significant amount of controversy over the ecological value of restoration activities facilitated by both federal and state wetland development permitting mechanisms. First, the very notion of "no net loss" in wetland restoration is contested, because it assumes that ecosystem degradation in one place can be ameliorated by ecosystem improvement in another place. Though both federal and state regulators require that mitigation credits be generated within some proximity (for example, the same watershed or 8-digit hydrologic unit code) of the development impacts they are offsetting, there is a great deal of disagreement in the scientific community over the spatial equivalence of off-site compensatory activities (Bedford 1996, Race and Fonseca 1996, and Zedler 1996). And as noted in BenDor et al (2009), wetland mitigation programs enable "relocations" of restored wetlands across space and, significantly, type of space (e.g. from urban to rural, and/or between dissimilar ecological, social, and economic contexts). In a state-specific study of the stream and wetland restoration activities as permitted by the Army Corps of Engineers and fulfilled by the EEP, the authors found that average Euclidean distance between impact sites and compensation sites in North Carolina to be 54.7 km (34 miles), resulting in a loss of place-specific ecosystem functions in the tradeoff between impacted and restored sites.

In addition to the potential loss of ecosystem function, this program has also been demonstrated to have environmental justice and equity impacts. Again looking at wetland mitigation activities under the EEP, BenDor and Stewart (2011) find that aquatic resources (both wetlands and streams) tend to be lost in the whiter, better educated, and more affluent urbanizing areas of the state and transferred to less affluent, less well educated, and increasingly non-white communities. As discussed, this relocation jeopardizes the net ecological value (if not acreage) of the state's aquatic resources, but it can also hinder rural redevelopment activities (to say nothing of denying contact with streams and wetlands from urban dwellers, in particular those with marginal access to the political apparatuses that approved the impactful development). As was mentioned, most wetland mitigation activities are carried out by for-profit third parties (in North Carolina, typically working through the EEP), who acquire large tracts of rural land for conversion to mitigation banks. Since this land is privately held as a conservation asset, it denies rural communities the ability to either self-determine the character of those large areas, or to benefit from the revenue generated by the mitigation credits.

ELIGIBILITY IN KINSTON

In Kinston's case, however, this does not appear to be an issue. While the community's arrangement with the federal government undercuts its ability to cash in on the buyout zone's carbon storage and sequestration services, it seems that the public ownership of the wetlands comprising the buyout zone would allow the Kinston (and Lenoir County) to receive revenue from the wetland mitigation ecosystem services generated there. Should they choose to do so, Kinston and Lenoir County could either retain ownership of the buyout lands, voluntarily allowing the EEP (through a conservation easement) or a for-profit third-party to restore and manage the wetlands in exchange for potential tax benefits. Depending on the scale or the restoration activities, the EEP could pay up to 100% of the restoration costs. Or, the city could sell the land outright to the state or the mitigation bank and collect the one-time revenue from the transaction. The statute that enabled the federal acquisition explicitly permits both of these transactions:

> ***[Kinston] agrees that it shall convey any interest in the property… only to another public entity… However, the Grantee may convey a lease to a private individual or entity for purposes compatible with [open space, recreation, or wetland management]. Conservation Easement that shall be recorded with the deed and shall incorporate all terms and conditions set forth herein, including the easement holder's responsibility to enforce the easement.***

Both of these approaches would enable Kinston to leverage the wetland ecosystem services of the buyout zone to generate revenue that it can invest in pro-resilience measures. Additionally, both would ensure relatively speedy capitalization on the asset, and neither requires substantial effort—on either long- or short-term bases—from either the city or the county. However, both scenarios require Kinston to forfeit some degree of autonomy over the buyout zone. In essence, both of these transactions involve the city divesting, either partially or entirely, 750 acres of land to the state. Clearly, this would limit the amount of autonomy that local government would have in making decisions regarding the current and future uses of that landscape, and it would greatly limit the extent to which the community could incorporate the input and wishes of the former residents of Lincoln City into the restoration agenda.

Accordingly, it might make sense for Kinston to pursue a third option: either unilaterally or in conjunction with a private partner establishing their own mitigation bank to encompass the FEMA buyout zone. Such a bank would be able to develop and monetize Section 404 mitigation credits over time, while maximizing local control over the tenor of restoration the restoration activities. Additionally, while the political/economic arrangement might begin as a tool for monetizing the mitigation credits on the buyout zone, it might evolve to include other wetland tracts in the city, county, and region. In its Federal Guidance for the Establishment, Use, and Operation of Mitigation Banks, EPA explicitly enables the establishment of mitigation banks that generate Section 404 credits on public lands, and/or through partnerships between public agencies and private mitigators.

Establishing its own mitigation bank (or collaborating with a private entity to do so) would have a number of drawbacks. First, in order to get permitted and approved for credit sales, a Mitigation Banking Review Team (MBRT) comprised of federal and state government regulatory agencies must approve plans for the bank. It could take years for the MBRT to sign off on the hydrological and planting design strategies for the bank. Additionally, once approved, a mitigation bank would offer less cost certainty than outright sale of the land on which the mitigating services take place. EEP Mitigation Bank Credits are purchased through an annual request for proposals, in which banks compete to sell credits to the state at the lowest price. Both supply and demand vary annually, so it would be difficult for Kinston (and their potential partners) to forecast the expected revenue from the sale of any mitigation credits generated within their hypothetical bank. Nonetheless, the sustained stream of revenue (no matter how variable) and the autonomy in decision making regarding wetland restoration activities seem to make this arrangement favorable to either a conservation easement or outright sale of the property.

Kinston does not have to look far to find precedent for municipally held and managed wetland mitigation banks. After relying on mitigation credits generated by the joint city-county Storm Water Services' Wetland Restoration Program, the city established the Umbrella Stream and Wetland Mitigation Bank to facilitate public projects within Mecklenburg County's jurisdictional limits. Like the state-level EEP, Charlotte's mitigation banking program arose to eliminate delays in the implementation of public projects that required extensive wetland crediting with which the private sector was not keeping pace.

In both of these cases, public agencies designed their mitigation banks to respond to development pressures, an issue that rural communities like Kinston do not seem likely to face in the near future. Nonetheless, two trends bode well for the marketability of wetland credits generated in Kinston. The first is the explosive growth of the Raleigh-Cary metropolitan statistical area (MSA). Though it fell two spots from the previous year, the MSA still ranked as the nation's fourth fastest-growing in 2015 (Forbes, 2015). As the Raleigh area's rapid growth continues to overwhelm existing infrastructure and capacity for growth management, it's conceivable that the MSA's expansion will migrate away from established nodes in the northern and western areas of the city's core, where drivers like the Research Triangle Park and RDU International Airport have historically attracted suburban development. Rather, the largely agricultural uses that define the eastern portion of Wake and Johnston Counties may be poised to convert to more developed uses. As this development moves east, it begins to enter the regulatory jurisdiction of wetland credits generated in Kinston's hydrologic unit area, currently a mere 70 miles from the state Capitol in downtown Raleigh. This may make the buyout zone a potentially lucrative source of mitigation credits and therefore revenue for the municipality, should it decide to modify and manage the land in this way.

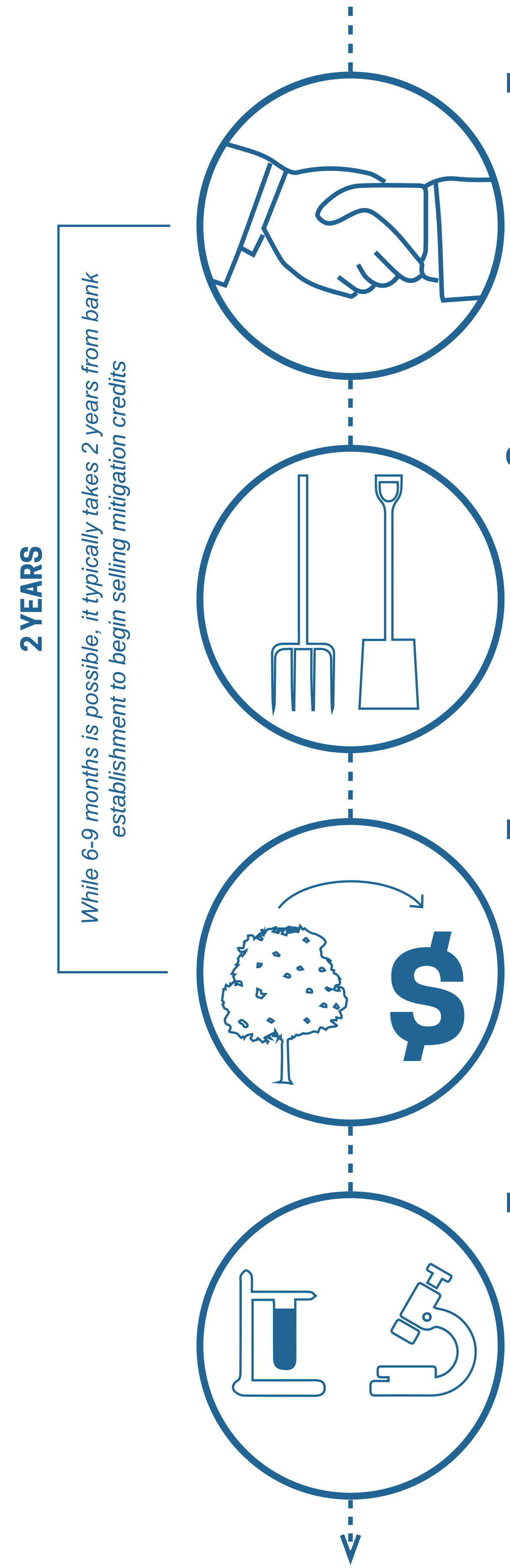
The second and similar trend is the eventual inland migration of the state's coastal populations. Though controversial actions like the passing of HB 819, which outlawed the findings of the state's own scientists regarding the severity of sea level rise in North Carolina, indicate the legislature's obstinate position regarding the new ecological normal, it seems likely—if not certain—that the public and their representatives at local and state levels will be forced to embrace both the scientific consensus and empirical realities of a changing climate. As North Carolinians acknowledge the fatalism of life in places like Kitty Hawk, Belhaven, and even Elizabeth City, nearby cities on higher ground in the coastal plain like Greenville, Jacksonville, and Kinston may be preferable to these kind of climate immigrants than Raleigh, Charlotte, or elsewhere out of state. Again, this trend could result in future development pressures in and around Kinston that would enhance the value of the mitigation credits generated at the Kinston buyout zone.

In exchange for maximizing its share of the available revenue from the sale of wetland mitigation credits produced on the FEMA buyout site, Kinston would serve as the bank's sponsor, assuming a significant amount of responsibility for the implementation and continued maintenance of the site's ecology. Federal rules require involvement from an Interagency Review Team (IRT) comprised of standing members from the US Army Corps of Engineers, the EPA, and state environmental quality agencies (in North Carolina, that would be DENR), as well as invited members from local government, state and federal fish and wildlife service, and appropriate Native American tribes. The IRT collaborates with the bank sponsor to design and implement a wetland project that meets local priorities while conforming to federal standards. Once the entire IRT endorses a design and a plan for monitoring maintenance of the wetland, construction can commence. Credits can be sold to entities needing to compensate for wetland loss as soon as the IRT certifies the project complete, a process that typically takes two years. As the bank sponsor, Kinston would also responsible for the monitoring, maintenance, and perpetual preservation of the designed wetland functions (Figure 14).

Both the monitoring and construction phases of wetland banking require detailed expertise in environmental engineering and design. The next chapter discusses how to incorporate a place-specific community design process into environmental design in Kinston.

Figure 14: ESTABLISHING + OPERATING A MUNICIPAL WETLANDN MITIGATION BANK

These steps will allow Kinston to operate their own mitigation bank and maximize available revenue from ecosystem service provision in the FEMA buyout zone.



ESTABLISH

City of Kinston (bank sponsor) allocates responsibility for the implementation of the wetland banking strategy. Potential lead agencies include **planning + zoning, City Manager's Office, and Public Services.**

Consider partnerships with Neuse Regional Water and Sewer Authority, the Clean Water Management Trust Fund, and environmental conservation non-profits.

CONSTRUCT

City collaborates with Interagency Review Team (IRT; state and federal partners at DENR, Army Corps, EPA, and elsewhere) to design and construct wetland. Implementation may not begin until the bank sponsor receives approval from the IRT.

During the public bidding process, consider emphasizing **prior experience in synchronizing wetland design with public amenity provision** as a selection criteria.

MONETIZE

Once the wetland has been developed, the IRT will determine credit eligibility, and Kinston may begin selling the credits for revenue.

Credits may be sold until the total allotment has been reached, at which time no additional credits can be sold from the bank.

MONITOR

As the bank sponsor, the city is responsible for the ongoing monitoring and maintenance of the wetland functions from which the credits emanate. **The wetlands must remain in the conditions laid out in the approved plan in perpetuity.**

Consider partnerships with universities, and/or for-profit environmental consultants such as Green Assets for ongoing monitoring responsibilities.

4. COMMUNITY DESIGN PROCESS

May 2014: the 7th Annual Lincoln City Reunion

Typically, we think of public services that landscape architects can provide as traditional kinds of design work deployed in non-traditional settings, often for little or no compensation. The ASLA Community Service Award, for example, is given to designers "who have provided sustained pro bono service to the community demonstrating sound principles of values of landscape architecture," and past recipients have won for their work in greenway design, landscape design in marginalized areas, and downtown revitalization through urban design strategies.

The proposal for and execution of the 2014 Wendy L. Olson Fellowship Enhancement for Public Service in Landscape Architecture emanated from a perhaps slightly different conception of the ways that landscape architecture can contribute to the world. While fields like urban planning may emphasize the value of consensus building and dialogue in the (re)development process more than fields like engineering, architecture, and landscape architecture, that emphasis doesn't necessarily mean that urban planners are successful at community engagement. In particular, massive national shifts in demography—towards a less white, less English dominant, more divided, and more technologically proficient America—seem to make the traditional "public meeting" model of design development increasingly obsolete. As designers with commitments to public service hunt for more creative, and ultimately more effective ways of consulting with the user groups who must buy in to and sustain designed interventions in the built environment, landscape architecture can offer some compelling lessons to ensure that design and development are more equitable, more democratic, and generally better in the future.

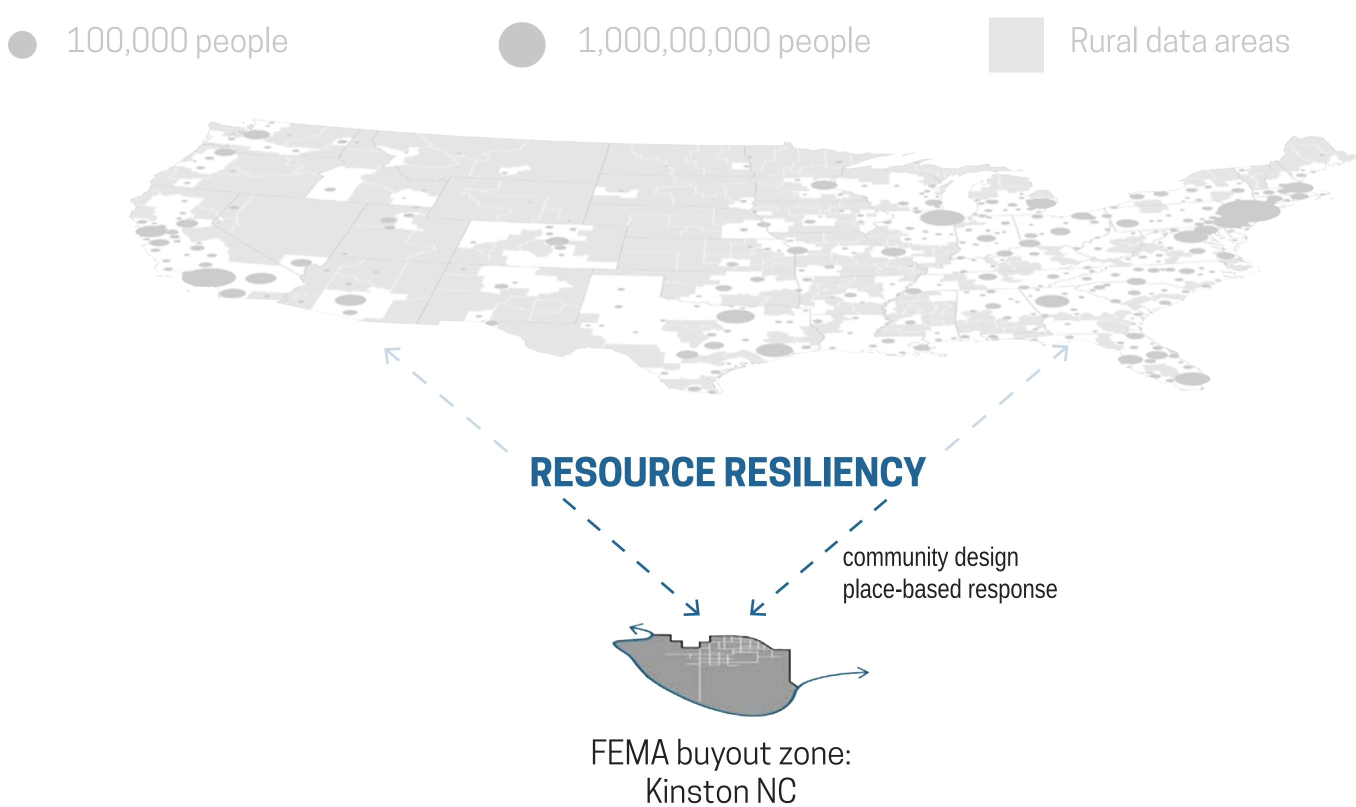
Furthermore, while the previous chapter outlined techniques of thinking about and profiting from the ecological resources and natural capital that compose Kinston's FEMA buyout zone, a community design approach can be instrumental in leveraging that site's human capital. Engaging members of the Lincoln City community in the redesign of the land that used to be their neighborhood adds a human dimension to resource resiliency, scaling the approach down and embuing it with specific, contextual elements and situating the design work in this particular place (Figure 15).

SETTING

The degree to which Kinston and Lincoln City in particular was fractured, both by the flooding precipitated by Hurricanes Fran and Floyd and the buyouts that followed, should be well understood. But what must be noted is that, despite both the ecological carnage visited upon the community by these and previous other cataclysmic events and the 15+ years that have intervened since the buyouts were completed, the Lincoln City and greater Kinston diaspora remains engaged in and deeply connected to each other and their old community along the Neuse. Since 2007, a grassroots network of former Lincoln City residents have been organizing the Lincoln City Reunion (LCR), a weekend-long commemoration of the heritage, culture, and relationships forged in the pre-buy out community. What started out as an effort to assemble buy-out refugees who moved elsewhere after their property was acquired, has evolved into a convention of African Americans from all over the country, and a major celebration not only of Lincoln City's culture, but of a wider, more general cross section of black culture nationwide. Unofficial estimates for attendance of the 2014 LCR range up to 3000 people.

Figure 15: SCALING DOWN

Community design adds a human dimension to the resource resiliency approach, and scales the project down to apply specifically to the Kinston context.



PROCESS

I attended the 2014 LCR (with an assistant) so that I could engage the attendees and solicit their ideas for the re-invention of their former neighborhood. To be clear, the imperative for this engagement process was not to harness the momentum of some existing redevelopment project or even to add a marginalized voice to a larger community dialogue surrounding design in the buy-out zone. Aside from some early (some say unilateral) efforts at programming and schematic site design, there is virtually no energy or resources for reimagining the former Lincoln City within city government or, to my knowledge, the private or non-profit sectors.

To craft my engagement strategy, I first reviewed innovative community engagement and community design strategies. In addition to considering foundational work in the field by Sanoff (1979, 1992) and Hester (1990, 2006), I also looked at strategies by described by Hou and Rios (2003), Boone (2012), and the Detroit Community Design Center. I then crafted a four-pronged engagement methodology that I believed to be most appropriate and feasible for this project and this community. The activities were:

Mental mapping: Using a mosaic of historic Sanborn Insurance maps covering the buy-out zone , LCR attendees were asked to use the map to pinpoint specific memories, associations, or other thoughts that the map precipitated. They were then asked to draw these on the map (Figures 16-18).

Differential valuation: I produced a physical, laser-cut model of the buy-out zone, including the river, the outlines of the defunct streets, and the locations of existing and functional infrastructure in the area (Figure 16). Additionally, I produced scaled versions of affordances that would conform to FEMA's requirements for floodplain redevelopment, and that I anticipated seeking to incorporate in my redevelopment scheme. These affordances included a dock, two sizes of open-air pavilions, soft and hard paths of various lengths and shapes, and several baseball

mental mapping with Sanborn insurance maps (Fig. 15)

mental mapping with physical topographic models (Fig. 15)

(in)formal interviews with community members (Fig. 16)

documentation through social media (Fig. 17) fields.

Participants were asked to select their menu of affordances, and array them on the model. However, the activity artificially imposed budgetary constraints on the available programmatic options. Each feature was assigned a point value ranging from 1-5. Features that required more maintenance or up-front installation costs (such as the baseball fields) had higher point values than lower maintenance, more affordable features (such as the soft path). Users were allowed to choose whichever features they wanted, but they were given a limited amount of total points to spend on their program.

Formal interviews: I prepared an interview instrument to guide formal conversations with interested LCR attendees . The questions in the protocol ranged from general background information on the subject including their relationship to the neighborhood, to their memories, associations, and experiences with Lincoln City, to more specific prompts regarding their thoughts on Kinston's larger trends and needs. Additionally, I included several prompts intended to determine what role sustainable agriculture could have in a redesigned Lincoln City. Like the curated features in the differential valuation activity, these prompts stemmed from my own expectation that sustainable agriculture would figure prominently in my design alternative.

Social media documentation: Participants were asked to broadcast their experiences, both with the engagement activities but more generally at the reunion event, to the social media outlets Twitter, Facebook, and Instagram with the hashtag #MyLincolnCity. This was intended both as a low-barrier tool for documenting and sharing the event, and as a way to engage younger participants in the protocol.

Initially, all of these activities were housed in a pop-up tent at the entrance to the reunion grounds. Attendees either came to the tent on their own volition, or were brought there by LCR organizers and volunteers. Later in the day, though, we began actively recruiting participants to come to the tent, or simply approaching them with the interview protocol.

Figure 16: MENTAL MAPPING: QUALITATIVE DATA THROUGH HISTORIC IMAGERY

Sanborn Insurance Maps provide detailed archival data about communities across the US, and can serve as engaging tools for discussion and community design.

RESULTS

Initially, I had planned on employing a variety of engagement strategies in order to elicit different kinds of input from the participants. The most significant benefit of using multiple activities, however, was that the redundancy helped offset ineffectiveness in one or several activities. Ultimately, this helped ensure that I could obtain some meaningful design inputs, despite the unanticipated failure of several of the activities. Perhaps the least successful engagement strategy was the differential valuation activity. Virtually every participant had to be directed to the modeling area of the tent—for whatever reason, people simply did not gravitate to the activity.

Once participants were encouraged to participate in the activity, they generally found the rules confusing and uninteresting. When pressed to follow through with the activity, the sum of the responses did not reveal any significant information about how the community valued the various features involved in the redesign scenarios. There are several potential ways to improve this activity in the future. Generally, the model and its appurtenances could be bigger, more colorful, and more varied. Though his work is more conceptual and schematic than I intended this strategy to be, James Rojas's work can serve as useful model for tinkering with the differential valuation activity. Additionally, it may be more effective to have people participate in the activity in groups, rather than on an ad hoc, individual basis. This logistical tweak could make the activity more of a collaborative and enjoyable experience, while also making it easier and more efficient to communicate the rules.

Though minor, the differential valuation activity did have the unanticipated benefit of serving as an opportunity for community education. In explaining criteria I used to select the features that participants could choose from, I learned that many former Lincoln City residents were either unaware of or confused by the federal regulations governing the types of design interventions in the buy-out zone. Many participants hoped to see some residential or retail development in the area, something expressly forbidden in the legislation that enabled the funding disbursal. This kind of misunderstanding can lead to unrealistic community expectations about floodplain development, and the activity proved an effective way of both identifying and addressing these gaps in community awareness.

From a community perspective, the social media engagement strategy was also pointedly unsuccessful in promoting dialogue and collaboration surrounding the event and the community design component within. Despite concerted efforts to target younger LCR attendees, most of the participants in the engagement activities were among Lincoln City's "elders," and while their decades of insight and wisdom would prove incalculably valuable in other activities, their lack of exposure to smart phones and social media meant that virtually none of the participants uses the #MyLincolnCity hashtag on any of the targeted social media platforms.

However, the concept of organizing and sharing the event on social media outlets, in particular Instagram, did prove valuable to me. Not only did it enable me to quickly and easily store the host of photo and video documentation I was amassing throughout the day, but it also provided a venue to include other designers from my social network in the community design process. Though very few residents participated in any online dialogue over the Reunion or the engagement process, the digital platform did host many informal conversations with design students from throughout the country who otherwise would not have known about the event or the project. It will likely prove impossible to quantify the impact of these informal interactions on the final design product, but I certainly view them as a relevant takeaway from the event, and the Olson experience in general. If nothing else, the social media engagement strategy from the Lincoln City Reunion has inspired me to more effectively incorporate a similar methodology into future community design activities.

Like the social media documentation exercise, the interview-based community engagement strategy did not succeed in the way I initially intended it to. But unlike the social media strat-

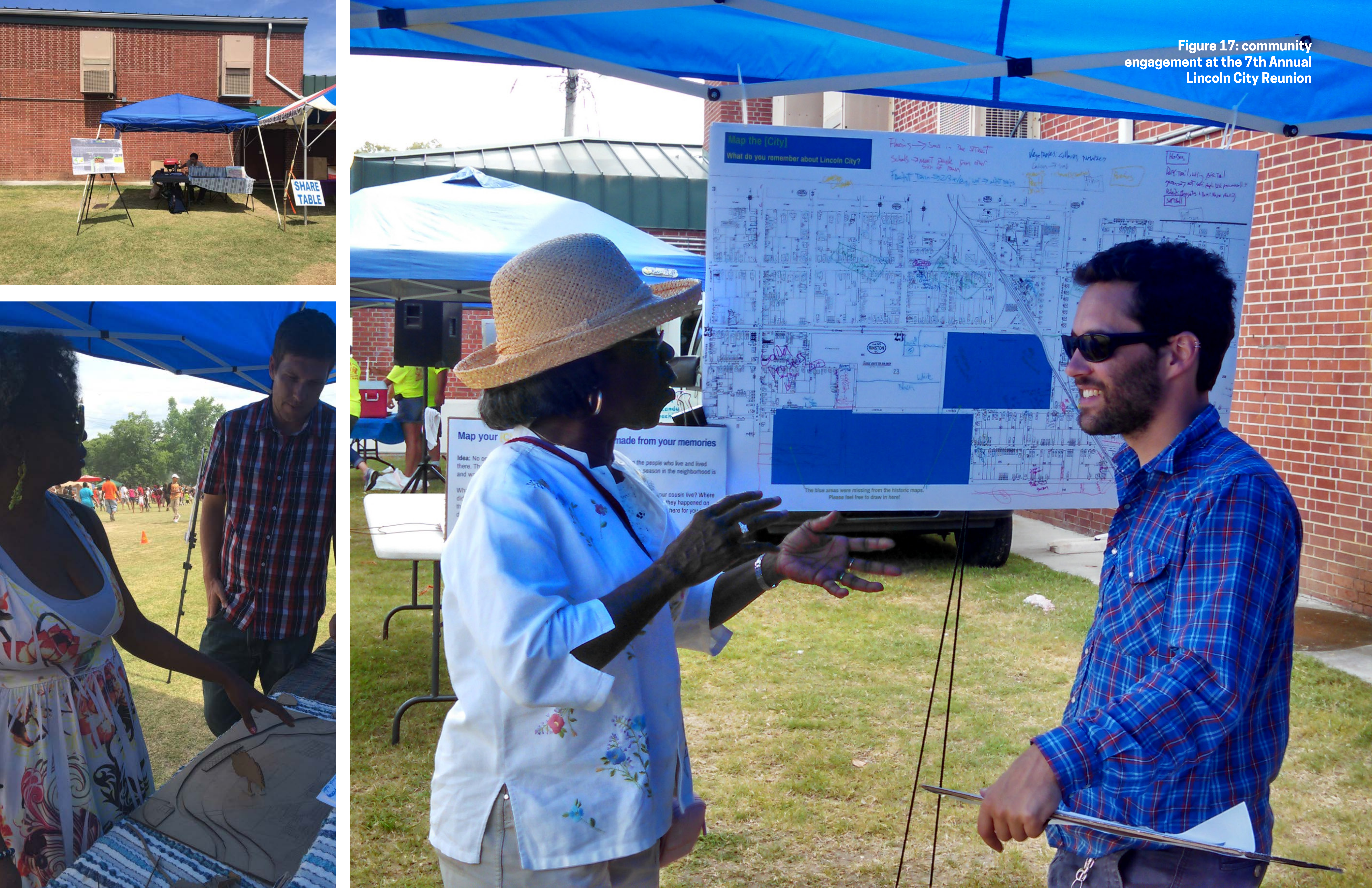


Figure 17: community engagement at the 7th Annual Lincoln City Reunion

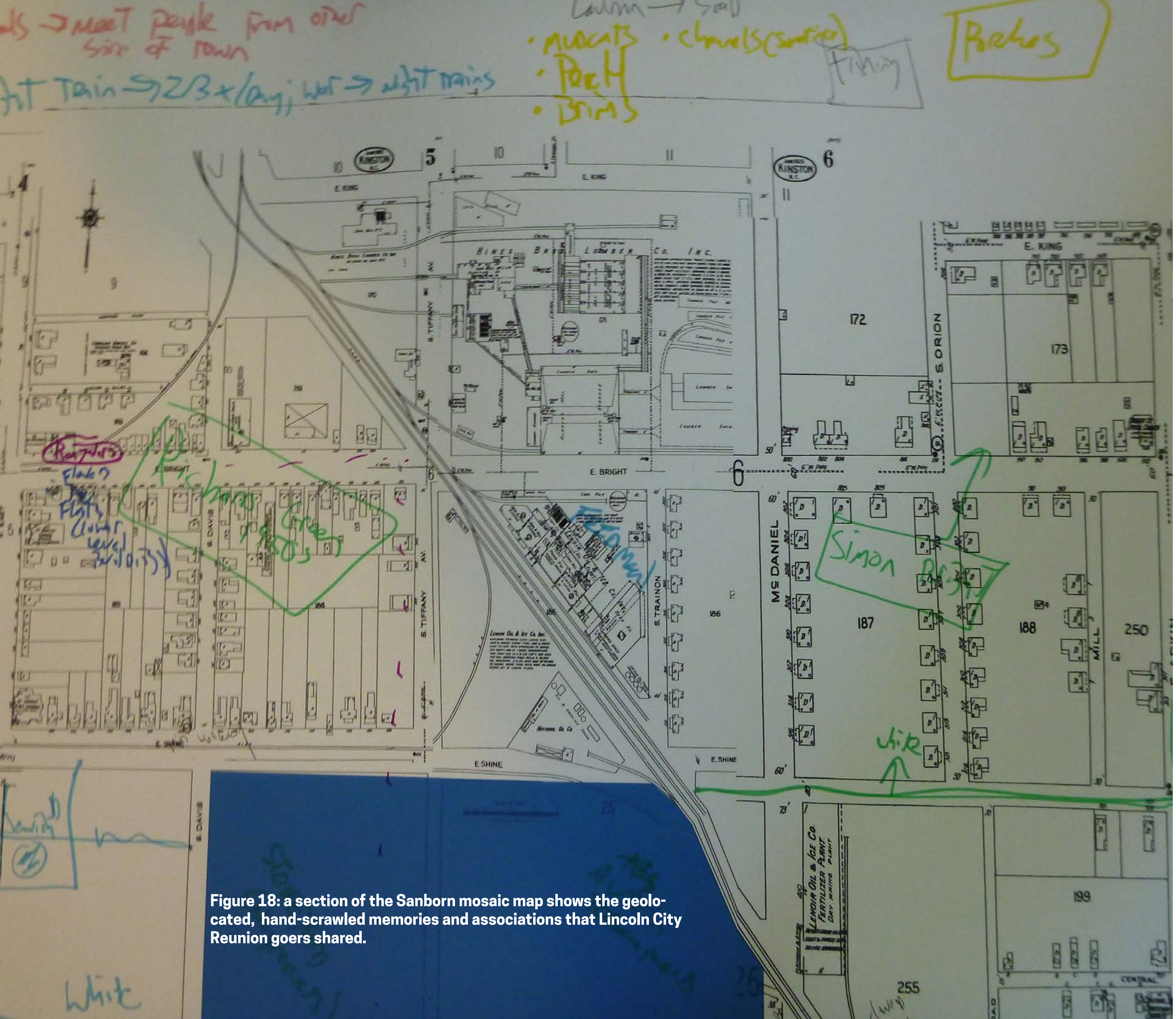


Figure 18: a section of the Sanborn mosaic map shows the geolocated, hand-scrawled memories and associations that Lincoln City Reunion goers shared.

egy, the relatively traditional interview methodology did reveal community knowledge that will prominently figure into the final design product next semester. Though imagined as a formal, intentional video interview with interested past and current Kinston residents, the interview strategy was quickly exposed as too rigid and time consuming for an amorphous celebratory event like the LCR. However, we were still able to deploy the interview instrument in less formal, more conversational situations, both at our booth and elsewhere on the Reunion grounds. We initially targeted the community "elders" who had spent most, if not all of their pre-storm lives in Lincoln City and still had strong cultural ties to Kinston and Lenoir County. In loosely structured interviews with these participants, we were able to address the various topics that our interview instrument was designed to flesh out more formally, from general background and memories to the more pointed questions regarding food and agriculture in the neighborhood.

As word spread throughout the day regarding our project, we were increasingly able to "interview" in this loosely structured way many younger former residents and get their thoughts on the same topics. Though essentially anecdotal and difficult to analyze in any rigorous way, these conversations had two major benefits. First, it allowed me to connect with a large sample of LCR attendees. For the interview component of the community design strategy, N=31.

The second major benefit of the interview-based community engagement strategy was that, when paired with the mental mapping activity, it produced by far the most useful and significant information for the design phase of the project. By themselves, the informal interviews provided interesting but often isolated information; memories, associations, and values tended to be specific to the interview subject. However, when enshrined on and prodded by the historic maps, the interview-mental mapping combination revealed a great deal about the community that I would not have anticipated.

These two activities were successfully synergistic, I believe, because the mapping component allowed participants to see what others had previously remembered. As the maps acquired more and more geo-located information about Lincoln City's past (Figure 19), they became increasingly potent conversation stimulators. More memories, associations, and place-specific thoughts about the neighborhood meant more opportunities to have memories jogged, sentiments stimulated, or for respectful disagreement about where a certain event took place or establishment was located. Rather than simply reflecting on static mental images and then sharing them with a comparatively uninformed outsider (me), as was the case in the informal interview activity, the mental mapping + interviewing protocol essentially allowed participants to interact with each other at different temporal scales throughout the day. In this way, the exchange precipitated by the mental mapping + interviewing mirrors one of the principle intended benefits of the social media activity.

But while this opportunity to remotely communicate with old friends and neighbors no doubt contributed to the shared success of the mental mapping and informal interview activities, the most compelling data emerged when participants were in the tent together. Rather than displaying it on a flat surface like a table, we chose to hang the Sanborn mosaic vertically, both increasing its visibility and allowing community members to converse while gathered around it. As participants stood and looked at the map, viewing and remarking on annotations left by previous informal cartographers, others would approach the map to add their own comments to what the initial participant's—or, in some cases, to offer their own interpretation of the same event or neighborhood landmark. Though perhaps galvanized by the mental mapping protocol, these interactions essentially fell outside of my community engagement strategies, and were less guarded, more natural, and therefore more revealing than any activity could elicit.

Of the technical takeaways from the community design process, this may be the most significant: design activities are important because they create an environment in which people can be honest with one another. The task for the designer or activity organizer is first to facilitate a safe or comfortable environment for this honesty to take place, and then subtly shepherd this honesty, targeting it to a specific topic so that it can be most useful. The next section details the most significant revelations from the community design protocol, and hints at how they might be incorporated into a redesigned post-buy out Lincoln City.

MAJOR FINDINGS

Sifting through the mountain of memories that remain from this former neighborhood and keying in on those that can and should be expressed in the landscape is one of design's most challenging tasks. Regardless of the elaborate engagement strategies that designers employ to elicit and record these memories, the story being told will invariably be a subjective one. For me, community design is ultimately about filtering other peoples' self-curated narrative through an individual designer's milieu. Moreover, to believe that one day of this (admittedly flawed) community engagement process could unearth enough historic, cultural, and otherwise qualitative information to cue design schemes for 180 acres of space would be both disrespectful and foolish.

That said, there were several themes that emerged from the joint interview-mental mapping activities. And while I don't claim that these themes represent the collective voice of the Lincoln City diaspora, I am attracted both to the frequency with which they appeared throughout the engagement activity, and their resonance with my own personal values. Some topics, in particular the racial and demographic profiles of each of south Kinston's housing projects (Carver Courts, Richard Greene, Golden, and Simon Bright), were both commonly identified and fascinating to me, but likely will not inform my redesign strategy. There are, however, several key topics that my proposed intervention will address.

The first is a general concept of resource sharing and communal living. For many participants, the maps conjured up memories of specific individuals who, through their generosity, empathy, or sense of civic obligation, were iconic figures in Lincoln City. For example, a participant left a note near the southern edge of the buy-out zone regarding a particular resident's willingness to share their tomatoes when their garden was particularly bountiful. Other residents shared that their primary association with a specific stretch of Lincoln Street is that it was where he and the other neighborhood boys would play sports—football, track, baseball, and "every other sport you can think of." Many residents share poignant memories of the vibrant porch culture that used to thrive in the close-knit neighborhood. "During the day, there was always someone out on their porch in Lincoln City. Doesn't matter how hot it got. Always." It could be argued that creating public spaces that encourage this kind of shared civic experience should be the goal of ALL urban design, regardless of the community design process that presaged it.

Perhaps, but through the engagement process, I intend to create communal public spaces that are unique, pleasant to be in, and testaments to

Figure 19: VERNACULAR NORTH CAROLINA COMMUNITY STORES

Lincoln City Reunion participants had vivid memories of the neighborhood's general stores, whose striking vernacular architecture can be interpreted in the redesign of the FEMA buyout zone.

STORES

1. Davis Store: Croft
2. unnamed store: Gordonton
3. Murray's Mill: Catawba Co.
4. Moore Store: Swansboro
5. G.V. Davis Store: Warren
6. Mast Gen. Store: Wautaga Co.

Preservation North Carolina

Dorothea Lange/Library of Congress

Preservation North Carolina

Swansboro History

Watson Brown

Preservation North Carolina

this community's particular narrative. Similarly, many participants were eager to share the details and locations of the many area grocery and corner stores (Figure 20.)

In the blocks surrounding where Lincoln Street intersects with the railroad, for example, I counted four different grocery or corner stores, and one filling station (and a clandestine juke joint). Like the street-turned-playground, these institutions served a larger community purpose than their primary one (commerce). They were hubs, public spaces were people would informally convene on the way to or from somewhere else; not necessarily a destination, but a culturally significant stop along the way. And like the vernacular porch concept, I think landscape architecture provides a unique lens through which to reinterpret both the form and function of this collectively remembered trope, in particular because the terms of the buyout preclude intensive structural development on the site.

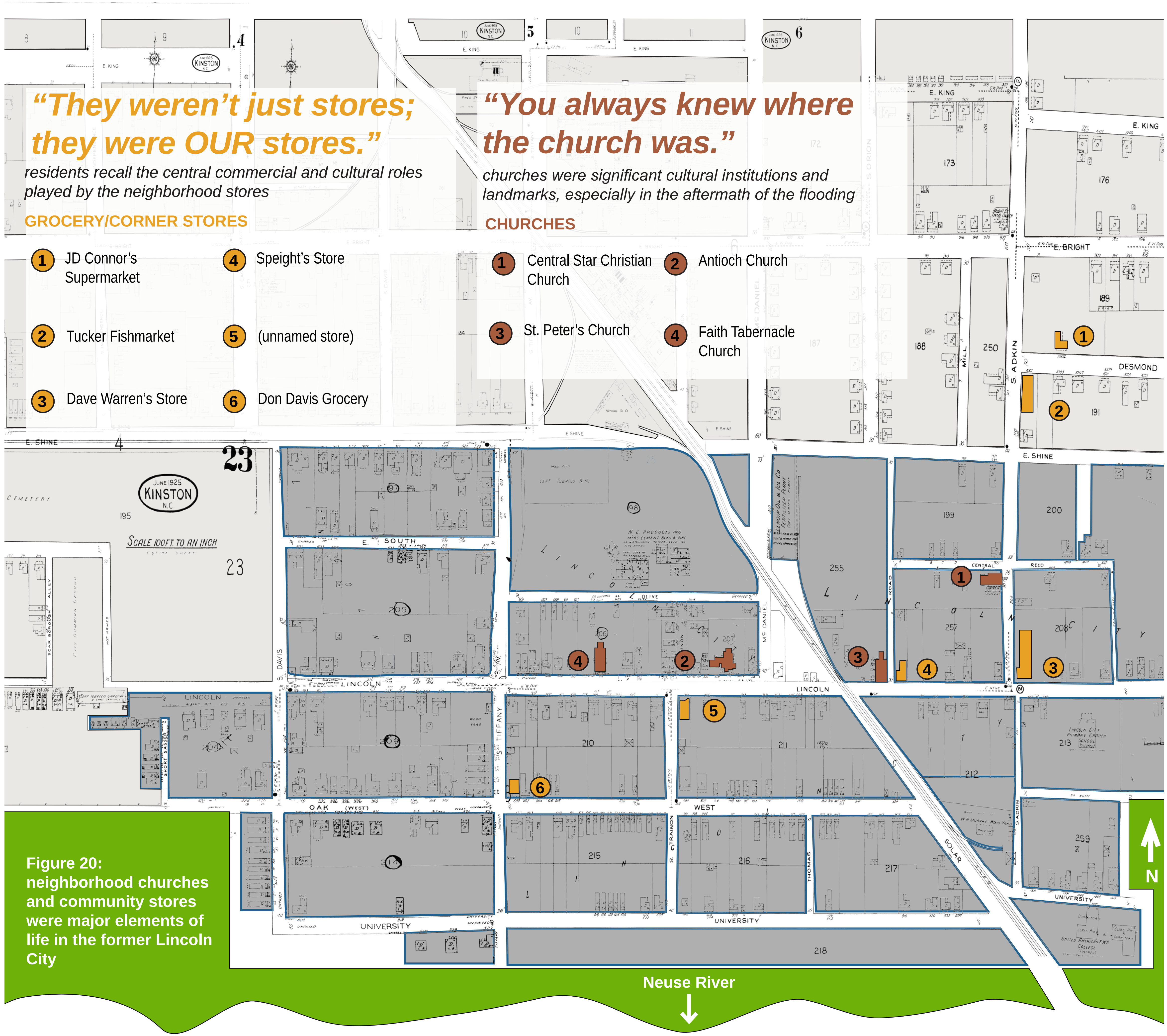


Figure 20: neighborhood churches and community stores were major elements of life in the former Lincoln City

5. SOLUTIONS

Neuse River wetland: Lenoir County, NC

In Chapter 3, I discussed a framework for how ecosystem service operationalizing can inform a masterplan for Kinston's FEMA buyout zone that both generates revenue for the community and conforms to the regulatory constraints placed on the property by the terms of the buyout. In Chapter 4, I described how a community design process can help incorporate the preferences and experiences of the Lincoln City community into this kind of human-centered ecological design. In this chapter, I will explore how to weave these two approaches together to produce a contextual and productive landscape that can enhance the site's ecosystem service function, interpret its recent human history, and provide a holistic community amenity to begin addressing the public health threats of a changing climate in rural communities. The solutions proposed in this chapter are

ultimately a synthesis of the findings from the ecological process discussed in Chapter 3 and the community design process in Chapter 4.

ECOSYSTEM SERVICE ASSESSMENT

The ecological component of this integrative design process uses a quantitative ecosystem service assessment to provide evidence for the masterplanned scenario's ecosystem productivity. In Chapter 3, I introduced the concept of ecosystem service modeling as a way of assigning a dollar value to the natural functions of a site's ecological assets. As was mentioned, these models are less effective at modeling the market value of those functions, and more effective at modeling other kinds of economic value, such as social costs that the services help communities avoid. And that while these costs can be effective ways of communicating ecosystem service value in policymaking or academic circles, they both struggle to withstand the scrutiny of a population that remains disturbingly unwilling to embrace the consensus of the world's scientists regarding anthropogenic climate change, and do not communicate value in terms that truly resonate for stakeholders and decision makers in cash-strapped, low-resource communities like Kinston. In these contexts, thinking about ecosystem function in terms of actual revenue generation can be both more convincing and more pragmatic.

It has been discussed that determining this type of value is an incredibly laborious and technical endeavor typically carried out by for-profit third parties whose businesses are based on technical expertise that I do not have. Fortunately, as mentioned at the end of Chapter 3, the EPA has already done the hard work, determining that an acre of North Carolina riparian wetland such as that in Kinston can be expected to generate $36,000-$63,000 of wetland credits, which can be sold to generate real, tangible revenue that can be spent on projects like pro-resiliency design. With this assumption in mind, I think it is possible to use an ecosystem service model to evaluate such a design's contribution to a community's ecosystem function portfolio, even if that model quantifies social or replacement costs.

Of the many ecosystem service models, only i-Tree, "peer-reviewed software suite developed by the USDA [that] provides urban and community forestry analysis and benefits assessment tools (i-Tree, 2015)" is intended to work at a scale as small as Kinston's 750 acre buyout zone. Additionally, rather than relying on sophisticated GIS manipulation of raster maps for ground cover, elevation, and other ecological inputs, i-Tree works off of user-gathered field data.

i-Tree is composed of a suite of programs that analyze and quantify ecosystem service in slightly different ways. i-Tree Street, for example, is specifically calibrated to assess the benefits of a community's street trees. The slightly more advanced i-Tree Hydro models the impacts of

Figure 21: i-Tree ECO METHODOLOGY

Unlike most other ecosystem service models, i-Tree relies on field data gathered by the modeler. By inputting ecological data from randomly generated points throughout some user-defined area, the model can create a sampled value for the entire site's ecosystem service provision.

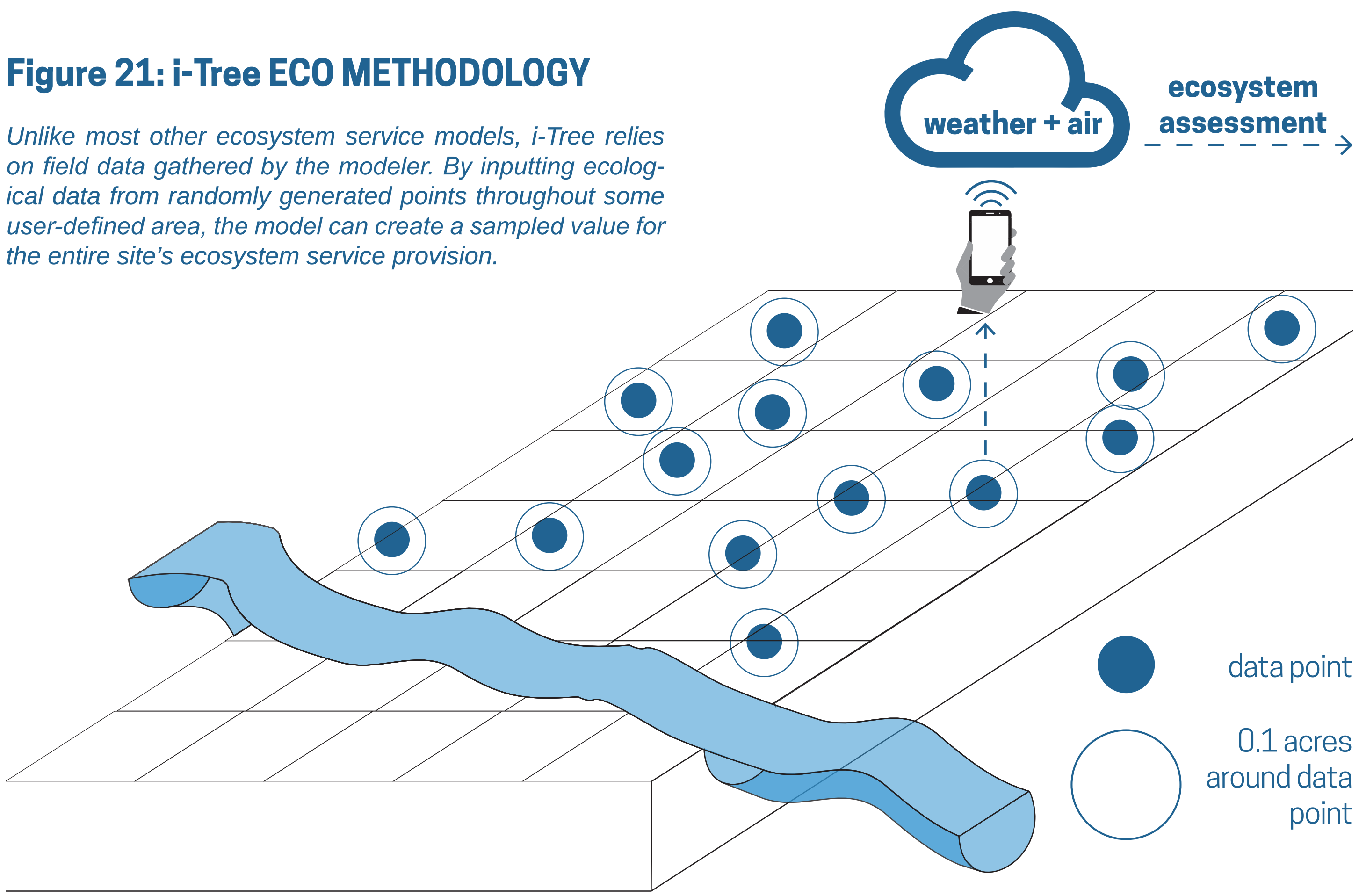
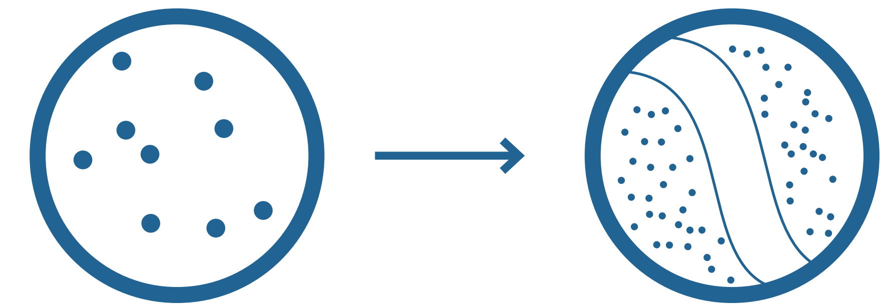


Figure 22: SOCIAL VALUE AS A SURROGATE FOR MARKET VALUE

Models like i-Tree provide baseline data that, when paired with known market values for ecosystem service provision, can evaluate the impact of an ecosystem modification on generatable revenue.



TYPE OF ECONOMIC VALUE MEASURED	existing ecosystem: baseline landscape and ecology before intervention	***modified ecosystem: landscape and ecology after an intervention***
SOCIAL VALUE [from ecosystem service model]	**$\$X_1$/acre**	***$\$X_2$/acre***
DIRECT MARKET VALUE [observed or proxy-based]	**$\$Y_1$/acre**	***If $X_1 \sim X_2$, then $\sim Y_1$***

changes in tree and impervious cover within on stream flow and water quality (i-Tree, 2015). While these programs no doubt offer compelling analysis of the relationship between development and ecosystem service provision, they are less useful in the Kinston case than the i-Tree Eco application.

i-Tree Eco is intended to present a broad picture of an ecosystem by quantifying urban forest structure, environmental effects, and values to communities. The application combines field data with local air quality and meteorological data to quantify the value of an ecosystem. The model filters user collected information on land use, ground cover, and a litany of data related to tree health through up-to-the-minute weather data to estimate the social costs of an ecosystem's environmental services, specifically carbon storage and pollutant removal (Figure 21).

The program is intentionally designed to provide a baseline figure of an ecosystem's worth so that land managers and designers can understand the impacts of development decisions, and while the model provides that baseline in terms of social costs, we can use the EPA's data as a baseline for the buyout zone's ecosystem service function in terms of market value. By using i-Tree to determine a baseline dollar value for Kinston's buyout zone, we are basically determining the i-Tree equivalent of $36,000-$63,000/acre worth of wetland credits. Then, by redesigning a new buyout zone and changing the inputs in the model to correspond to the proposed land use, ground cover, and vegetation characteristics of the new scenario, we can evaluate the extent to which the proposal impacts the baseline social, and therefore market, value of the site's ecosystem services (Figure 22).

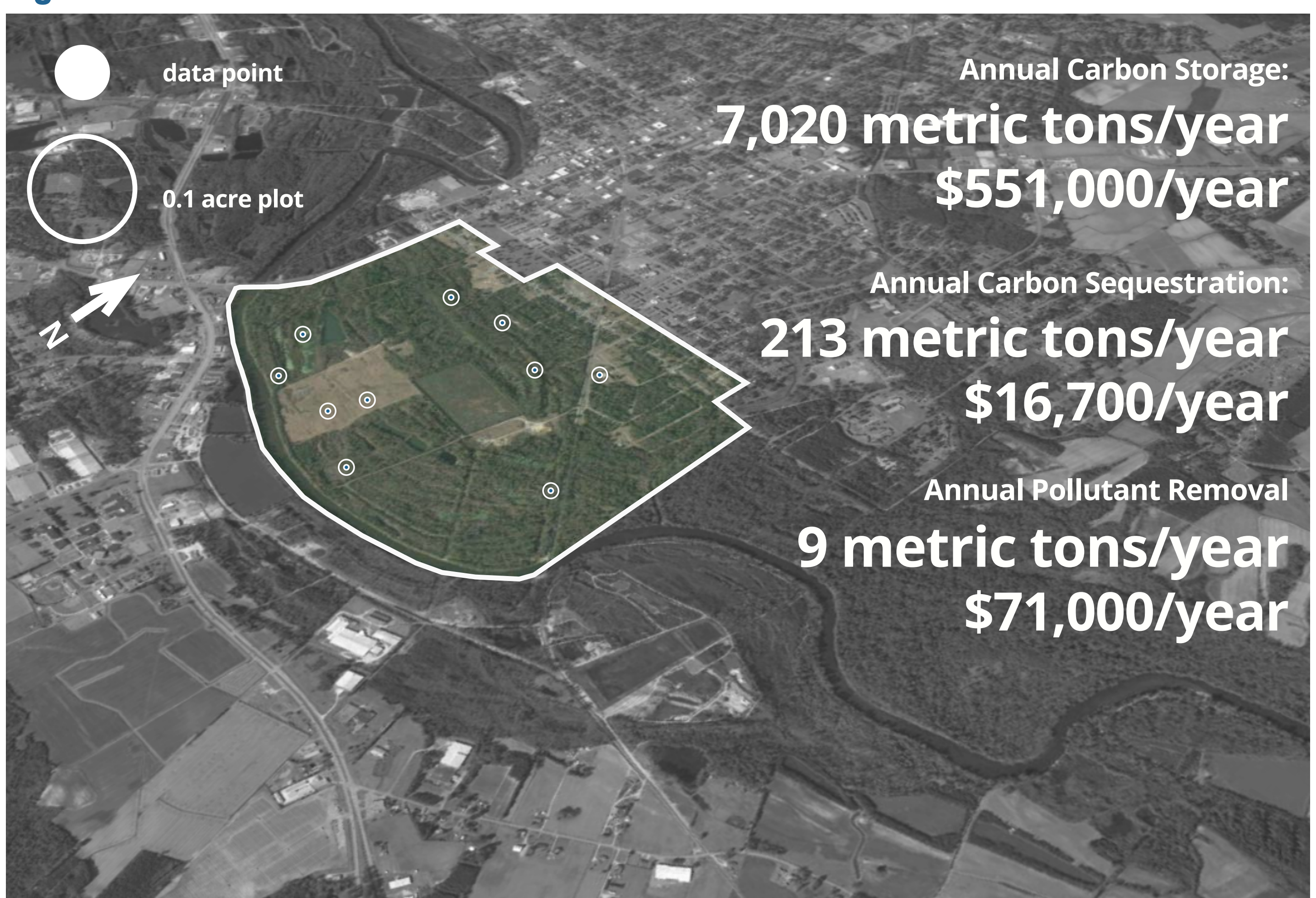
For example, Providence, RI recently used i-Tree Eco to evaluate the ecosystem function of their urban forests, determining values for the social costs of the city's tree pollution removal (91 tons/year; $4.7 million) and carbon sequestration

(4,030 tons/year; $287,000/year) ecosystem services. (i-Tree Eco Assessment Report, 2014). Let's pretend that an urban forest in New England has been demonstrated to be worth $50,000/acre on carbon trading markets (a figure completely invented for this exercise), so that the value of the city's urban forest on carbon markets would be $50,000 X the number of acreage eligible for carbon crediting (y). Let's next pretend that Providence has plans for a new greenway that spans the city. If the city were to re-run their initial i-Tree analysis, replacing the observed conditions in the field with assumptions that correspond to what would be observed in the field after implementing the greenway project, and get similar results for the city's urban forest productivity, then it can be assumed that the greenway would not deleteriously impact the carbon-market value of the city's urban forest. Y, in other words, would not decrease, so if we assume that the market value of a New England urban forest is constant, neither would the revenue able to be generated by the city's ecosystem services.

With this methodology in mind, I applied the i-Tree Eco model to Kinston's FEMA buyout zone. Using a GPS locator, I traveled to 10 points within the buyout zone randomly generated by the i-Tree application. Using the program's webform, I gathered information related to the land use, ground cover, and tree type for every tree that fell within in a 0.1 acre circle emanating from each of the points.

While determining inputs such as groundcover, current land use, and tree height and diameter were straightforward tasks, it was comparatively more challenging to determine some of the other inputs required by the model. For example because I gathered data in early spring, many of the trees had yet to leaf out. Therefore, I used the amount of dead branches in the crown as a proxy to estimate the percent crown missing for each tree.

Figure 23: EXISTING ECOSYSTEM SERVICE PROVISION



Using my smartphone, I uploaded the data for each 0.1 acre plot to the software, which filtered it through data from local weather stations and established assumptions for various variables related to the social costs of carbon storage/sequestration and chemical water treatment. Once back at my computer, I ran the model from the gathered data. The software then tabulated the data, producing an analytical report on the general state of the ecosystem, including its services and their value.

As Figure 23 indicates, i-Tree Eco determined that the social value of the site's annual carbon storage is $551,000/year (7,020 metric tons), annual carbon sequestration is $16,700/year (213 metric tons/year), and the value of the site's annual pollutant removal is $71,000/year (9 metric tons/year). See Appendix I for a more detailed description of the i-Tree calculation methodology.

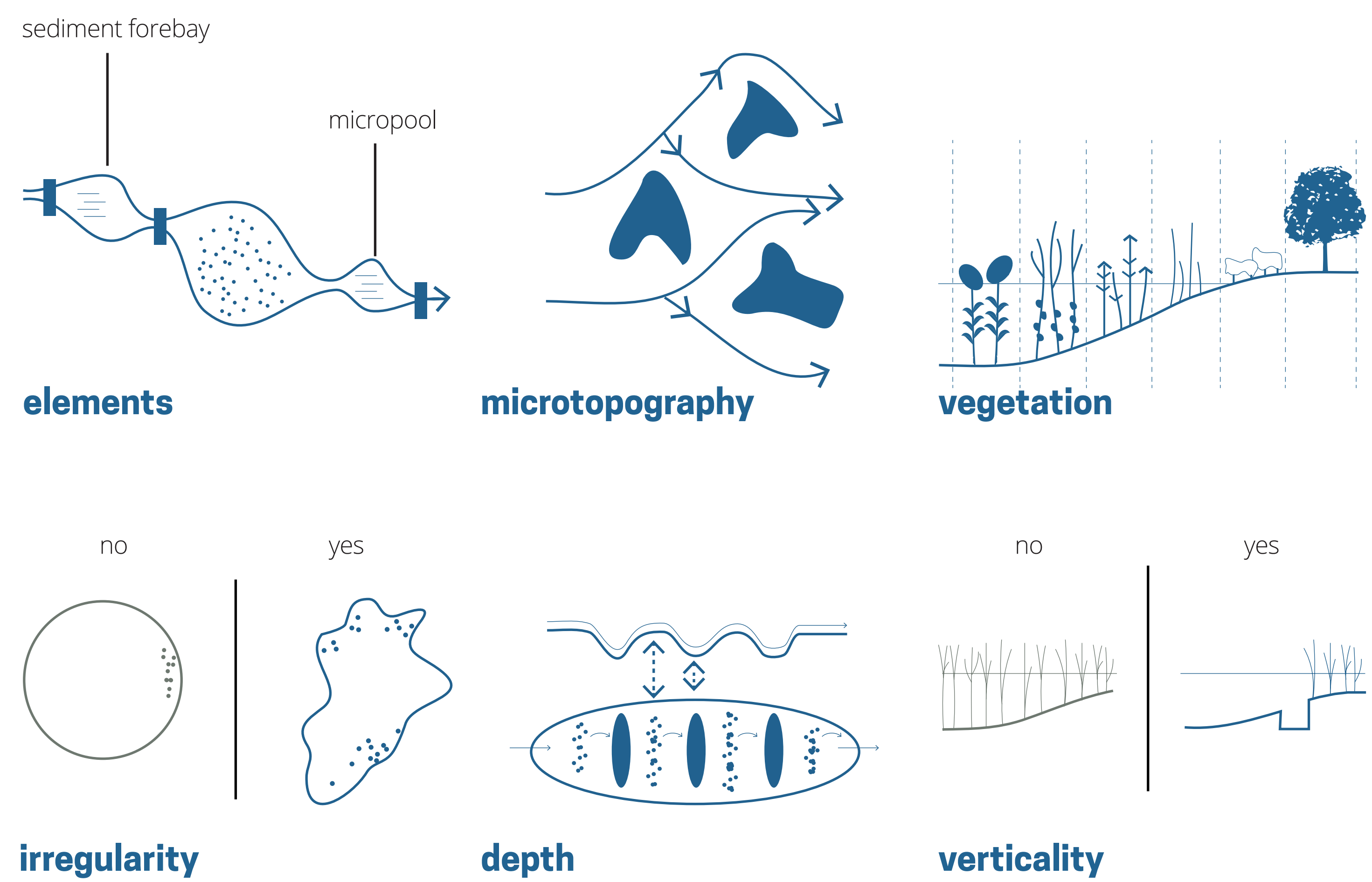
In other words, these are the conditions that correspond to $36,000-$63,000/acre worth of wetland mitigation credits. If we change the initial inputs through design, rerun the model with modified inputs, and arrive at figures similar to these conditions, then we can assume that Kinston would still be able to receive (at least) $36,000-$63,000/acre worth of wetland mitigation credits.

DESIGN STRATEGY

With the goals of enhancing ecosystem service productivity and reducing risk in a riparian wetland that frequently floods, it seems logical to focus using design to optimize wetland ecosystem function. Semantically, there are differences between wetland creation, restoration, and enhancement, which Lewis (1990) distinguishes between as follows:

Figure 24: PRINCIPLES OF WETLAND DESIGN

adapted from France (2003)



Creation: converting a non-wetland into a wetland

Restoration: returning a former wetland to a pre-existing condition

Enhancement: increasing one of more functions performed by an existing wetland

Clearly, the Kinston case does not involve creating a wetland, but while the site may qualify as both/either an enhancement and/or a restoration, the distinction is not significant because the design practices would be the same in either case. In addition to cataloging some of the strategies that apply to the various types of wetland design (Figure 24), France (2003) also recommends being explicit about the specific ecosystem services that a designed wetland is intended to optimize. Though it is true that wetlands are critical resources for a range of anthropocentric reasons, from the support they provide wildlife habitat to the aesthetic and recreational value they embody, not every wetland can adequately provide every ecosystem service. Indeed, Lewis (1990) notes that the balancing of tradeoffs between the provision of these and other ecosystem services is a critical part of successful wetland design.

In Kinston, I am recommending the restoration/enhancement of a riparian wetland for the generation of compensatory-mitigation wetland credits. In this marketplace, the only requirement is that the site remain a wetland in perpetuity—there is no specification for wetland use or ecosystem function. However, in this particular case, it is possible to rule out certain wetland design intentions based on its geographic and social context. For example, in Kinston's FEMA buyout zone, it is not necessary to emphasize the flood storage capacity of the designed wetland. Thanks to the buyout, this area of the floodplain has been generally free of development since Hurricane Floyd, meaning that a designed wetland would not have to protect riverside life or infrastructure. Similarly, the post-Floyd closing of the Peachtree Wastewater Treatment Facility removed the necessity for a designed wetland on this site to treat wastewater.

Instead, for a variety of reasons, it makes sense to emphasize the water quality and nutrient retention benefits of a designed wetland in Kinston's FEMA buyout zone. First, the legacies of Hurricanes Fran and Floyd indicate the danger that intensive agriculture activities pose to water quality in rural areas like Kinston. While it is true that the wastewater treatment plant has been relocated outside of the floodplain, the region's primary industry and land use remain industrial agriculture, meaning that future flooding is likely to disperse high concentrations of chemical fertilizers, pesticides, and animal waste throughout local ecosystems as well as those downstream. Additionally, given that most ecosystem models (including i-Tree) are capable of evaluating this particular ecosystem service, it makes sense from an analytical standpoint to emphasize a feature of wetland design that can be monitored and quantified with relatively little effort.

Next, I recommend designing a wetland that emphasizes wildlife habitat. Though evaluating this ecosystem service is problematic in many of the ecosystem service models, it is nevertheless a critical one because of the other services that it supports. A wetland that provides habitat for a range of biodiversity encourages high biological productivity, thereby fostering economic and cultural experiences through aquaculture and tourism. For example, according to NOAA (2000), freshwater sport fishermen spend $20.4 billion on durable goods and other expenses related to recreational fishing. This is in addition to the central role that wetlands play as commercial hatcheries for most freshwater fish.

PRECEDENT

Though wetland design is an increasingly common practice throughout the world, it is a challenge to find precedent that applies to Kinston's particular geographic and political setting. Many of the most successful wetland design projects, such as Waterworks Garden in Renton, WA (Lorna Jordan/Jones and Jones), the Water Pollution Control Laboratory in Portland, OR (Murase

Figure 25: PRECEDENT

Crosswinds Marsh in New Boston, MI (top), Crosby Arboretum in Picayune, MS (middle), and the Murdock Wetland Phytoremediation (bottom) represent enhanced and restored wetlands in rural areas that prioritize the nutrient retention, water quality enhancement, biodiversity, and/or recreation ecosystem services of wetlands.

Associates), and the Oregon Garden in Silverton, OR (Mayer-Reed/Interfleuve, Inc.) are explicitly intended to treat effluent from municipal wastewater plants. Though a visionary strategy for wetland design, this strategy requires specific practices that must meet strict regulatory performance standards and, as discussed, is not an appropriate design intention in the Kinston case. Furthermore, many of the most successfully designed wetlands that do serve design intentions similar to those I am pursuing in Kinston occur in or near more populated and developed areas.

For example, while the designed wetlands at Emerald Square Mall in North Attleborough, MA (ENSR, Inc) are intended to manage and improve stormwater, they surround a regional commercial hub less than 10 miles from Providence, RI and adjacent to I-95. Despite the similarity in intent between this exemplary wetland design and my proposal in Kinston's FEMA buyout zone, the significant contrast between physical and cultural setting make it difficult to apply lessons from the former to the latter. Nonetheless, Figure 25 points to three examples of large rural or exurban wetland design that emphasize water quality, wildlife habitat, and/or recreation stand out as potentially instructive cases.

Established in 1994 to mitigate the impacts from the development of Detroit's Metro Airport, 304-acre Crosswinds Marsh Park in New Boston, MI showcases how biodiversity can support a range of activities in a distant designed wetland. Formerly dry farmland, the wetland was created by excavating tons of dirt, manipulating neighboring drainage, and planting a host of wetland plants such as water lilies and marsh marigolds. According to the Wayne County Parks Department, the marsh supports 40 species of mammals and 147 species of birds, including bald eagles, blue herons, egrets, Virginia rail, and various water fowl. Due at least in part to the rapid growth of the marsh ecosystem's biodiversity, the park now hosts a variety of year-round recreational activities, including cross-country skiing, horseback riding, and most importantly, birding and hiking along the marsh's boardwalk system.

The 104-acre Crosby Arboretum in Picayune, MS represents a less actively designed but nonetheless managed wetland ecosystem. 50 miles from both New Orleans and Gulfport, the rural wetland is intended to preserve and share the unique biological diversity of the Pearl River Drainage Basin in south-central Mississippi and Louisiana. Rather than emphasize the recreational opportunities of the site, Crosby Arboretum is committed to providing educational experiences that revolve around restored and preserved native wetland ecologies. Instead of promoting activities like fishing and bicycling, which could have negative impacts on the plant and animal communities that thrive in the arboretum, designers and managers offer a range of education and outreach programs, immersing groups from regional schools, 4-H clubs, and elsewhere in a managed environment of over 300 rare or threatened indigenous trees, shrubs, wildflowers, and grasses.

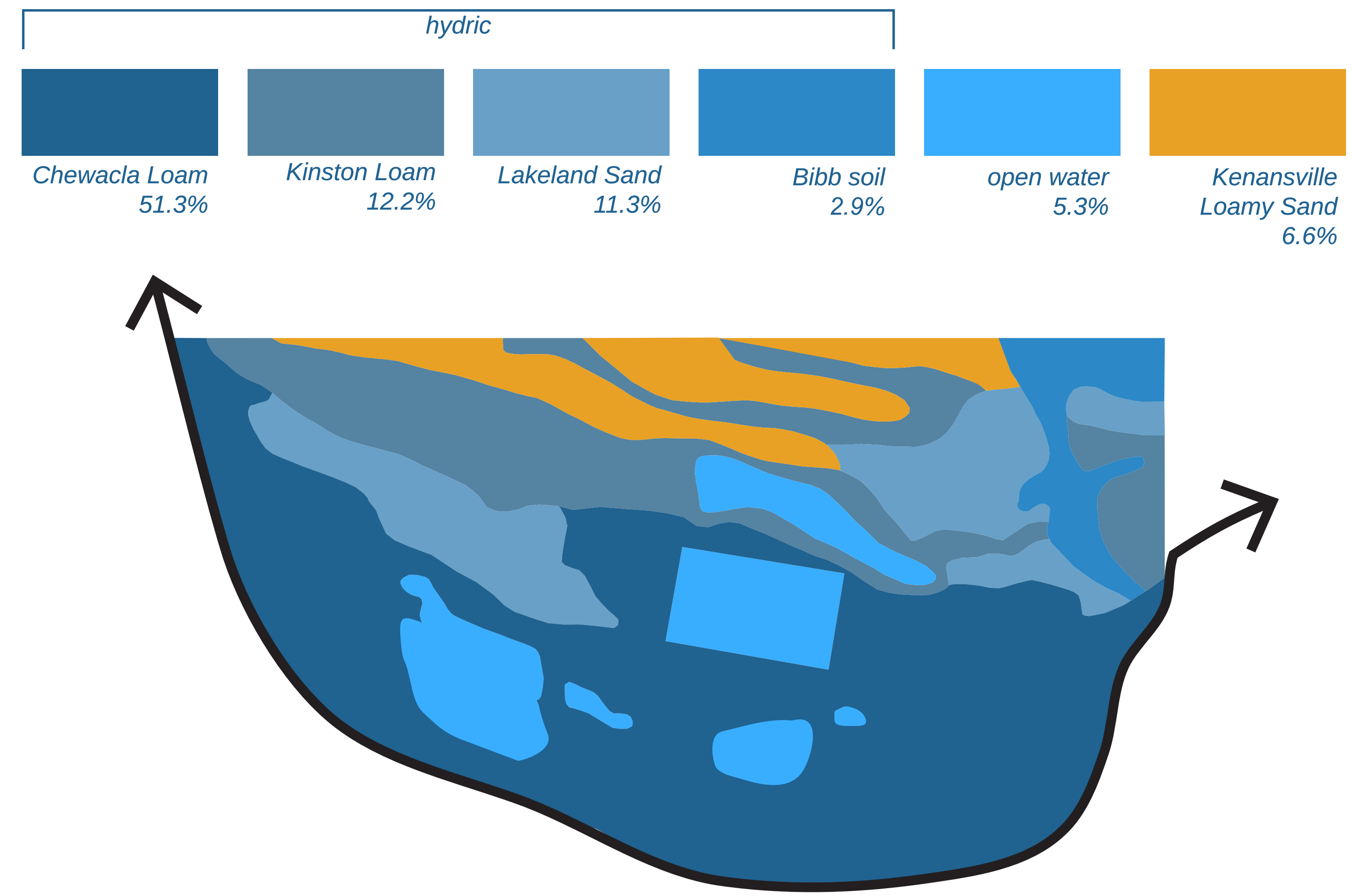
Finally, the Murdock Wetland Phytoremediation project 35 miles south of Omaha, NE exemplifies a designed rural wetland driven by water quality and ecofunction. After learning that local groundwater aquifers were severely contaminated by carbon tetrachloride wfrom neighboring industrial manufacturing, regulators required that the polluters address both the subsurface and surface contamination issues. To address below-ground contamination, Argonne National Laboratory implemented a phytoremediation regime that would confine and consume the pollutants in the roots of strategically selected and planted species of trees and shrubs. This solution was then complemented and enhanced by a constructed wetland to manage carbon tetrachloride in above-ground waterways, preventing contaminated water from entering a local stream. Managers now imagine this former contamination site as an amenity for local recreation and education, as well as a critical node of wildlife habitat.

PROPOSAL

My proposal for Kinston's FEMA buyout zone has two facets: an enhanced wetland that incorporates elements of these precedents, and a community amenity that interprets the responses

Figure 26: BUYOUT ZONE SOIL SURVEY

Understanding the arrangement of the site's hydric soils promotes the long-term success of enhanced wetlands in Kinston's FEMA buyout zone.



It should be noted that many of the concepts embodied in these precedents and featured in my proposal were schematically addressed in Kinston's Retrofitting Green, an open space plan approved in 2005 (but not implemented or funded). That plan generally recommends for amenities such as interpretive multi-modal trails, recreational facilities, open shelters, amenities for horticulture/agriculture, and minimally intrusive amenities for group camping, all of which are specified in my proposal. However, due to my prioritization of wetland ecosystem service enhancement, some elements of the Retrofitting Green plan are either de-emphasized or eliminated from the following proposal. For example, Retrofitting Green's recommendations for a skeet shooting range and a pine straw plantation are not consistent with my intended ecosystem service provision. They are not part of my proposal.

Enhanced Wetland

I recommend sculpting the landscape to both encourage the wetland to return to its pre-settlement state and expand the scope of the existing wetland areas. The southern portion of the site closest to the Neuse River is partitioned by earthen roads, vestiges of the area's pre-Floyd water treatment and landfill uses. As part of the buyout, Kinston was able to decommission these incongruous floodplain features, making them not only obsolete, but a hindrance to the site's wetland capacity. The roads essentially function like berms, segmenting several low-lying wetlands from each other and cutting into the site's revenue generating potential. Excavating the wetland-facing sides of these functionless roads, can both expand the creditable space into the stark, grassy remnants of the capped landfill, and in some areas, consolidate the disparate wetlands into a larger, higher performing unit.

These subtle interventions in the site's topography will increase both the size and function of the buyout zone's naturally occurring wetland features. Care can be given to achieving irregular edges throughout the expanded and added wetland areas, promoting more effective pollutant removal, and encouraging the biological productivity of animals that tend to occupy these rich ecological and spatial niches. In particular, birds like herons and bitterns prefer to nest along the edges of wetlands in the South, supporting predators like minks, snapping turtles, and even large-mouthed bass (USGS 2014).

By modifying the site's topography, water from existing wetlands (and ultimately, the wetland ecosystem itself) will freely move to adjacent areas. However, wetlands are composed of more than water. If a site is composed of well-draining soil, surface water will simply infiltrate into the ground negating any above ground wetland function. Targeting wetland enhancement efforts in areas with high concentrations of hydric soil ensures that water collected in an ehanced wetland will remain above ground long enough to provide animal habitat, remove nutrients, and perform other wetland ecosystem services. Using data from the USDA, I inventoried the site's soil composition to help determine the locations of the expanded wetlands (Figure 26). However, since the data for open water is based on aerial photos taken from an unknown date, the inventory for this particular soil type was supplemented with field observations from March 2015.

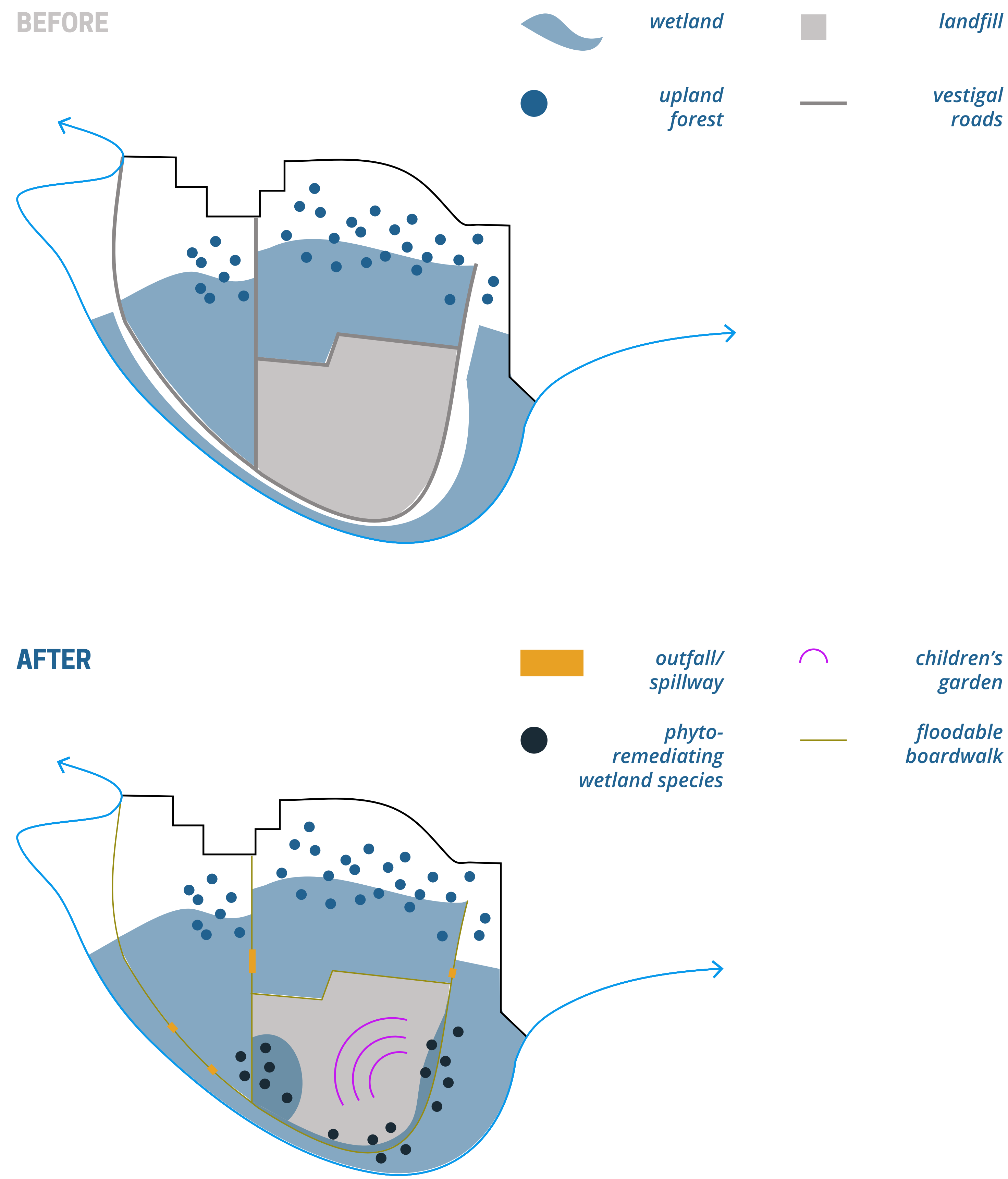
The overlaps between the expanded wetlands and the existing landfill offer opportunities to plant phyto-remediating wetland species, such as the large stands of poplars and willows that were used in the Murdock, NE case study. Additional phyto-remediation objectives can be supplemented by implementing a children's garden on portions of the remaining landfill area. The Retrofitting Green explicitly mentions establishing an arboretum to be managed by the Lenoir County Community College Horticultural program. While their recommendation is intended for the eastern edge of the buyout zone, it suggests that there is sufficient community interest in such an amenity for it to be a feasible, pragmatic way to improve both the site's ecological and cultural conditions.

The earthen berms can be replaced by a network of raised boardwalks that both provide multi-modal connections throughout the site and to the neighboring community (more on that below), and also treading lightly on the wetland ecosystem. Boardwalks offer a naturalistic entrée into the established and emergent wetlands, and can be designed to provide amenities for quiet contemplation, small gatherings, and recreational activities such as sport fishing and bird watching. Additionally, unlike costly and disruptive improvements like asphalt or concrete bridges, they can be flooded, destroyed, and rapidly replaced with easily accessible materials.
is essentially an easier, gentler, and less costly retrofit that will achieve the same results.

And in this case, the upland component of the natural wetland filtration process likely requires minimal intervention. In the 15 years since the buyouts, the upland forest has quickly returned to the former Lincoln City neighborhood. The tree inventory is now a unique mix of emergent young hardwoods typical of North Carolina's upland riparian forests— coniferous species like Loblolly Pine and Longleaf Pine, as well as coniferous species like American Sycamore, Sweetgum, and Laurel Oak—and mature exotics that were likely planted as ornamental trees during the neighborhood era of the site. In one case, several Eastern Red Cedars that were planted in a line along the former sidewalk share a former residential lot with resilient native saplings. While it will be critical to manage invasive species in the upland area of the site (and elsewhere), the existing forest composition appears to provide a strong foundation to support this step in the natural filtration process.

Figure 27: NATURUALIZED WETLANDS

By modifying the existing and outadated topography and implementing more adaptable mobility amenities, the site can return to a more ecologically productive wetland state.



future connection to AAMT
primary path (crushed concrete)
interpreted community stores
Lincoln City Community Park
existing church
enhanced buffer for Adkin Branch
secondary path (dirt and mulch)
existing wetland
additional wetland
children's garden
channels link wetland sections
N
0
2000 ft.

Lincoln City Community Park

The enhanced wetland is the primary element of the proposed design But while this sprawling this feature is in many ways a community amenity, the proposal also offers a more tangible, less ecologically driven community amenity. Occupying much of the former Lincoln City neighborhood, the Lincoln City Community Park provides community amenities that interpret the preferences and experiences of those displaced by the buyout. Filtering the results of the community design process through the regulatory constraints imposed by the terms of the acquisition program (Figure 29), I propose a collection of forms and spaces that reflect the community's narrative, respond to Kinston's particular cultural and economic context, and can mitigate some of the rural public health impacts of climate change.

These deconstructed community stores could be arrayed along the former Oak Street, the northern boundary of the buyout zone, with their porches facing north towards Lincoln St. Together, the south-facing platforms would open up onto a shared community green space that can be used for a variety of seasonally appropriate programming, such as health clinics in the winter, farmer's markets in the summer, concerts in the early fall, and the Lincoln City Reunion in the spring. Siting the Lincoln City Community Park on this axis not only reactivates a once-significant street in a culturally resonant way, but it also helps enmesh the facility in the existing community. Furthermore, it helps leverage existing neighborhood assets like Georgia Battle Park and the Kinston Music Park (Figure 28). Finally, the platforms will have to be designed to fit within the unique regulatory environment established by the terms of the buyout.

Figure 28: STRATEGIC SITING + ORIENTATION

The porch platforms of Lincoln City Community Park are located to reflect the historic character of the neighborhood, and leverage existing amenities and settlement patterns

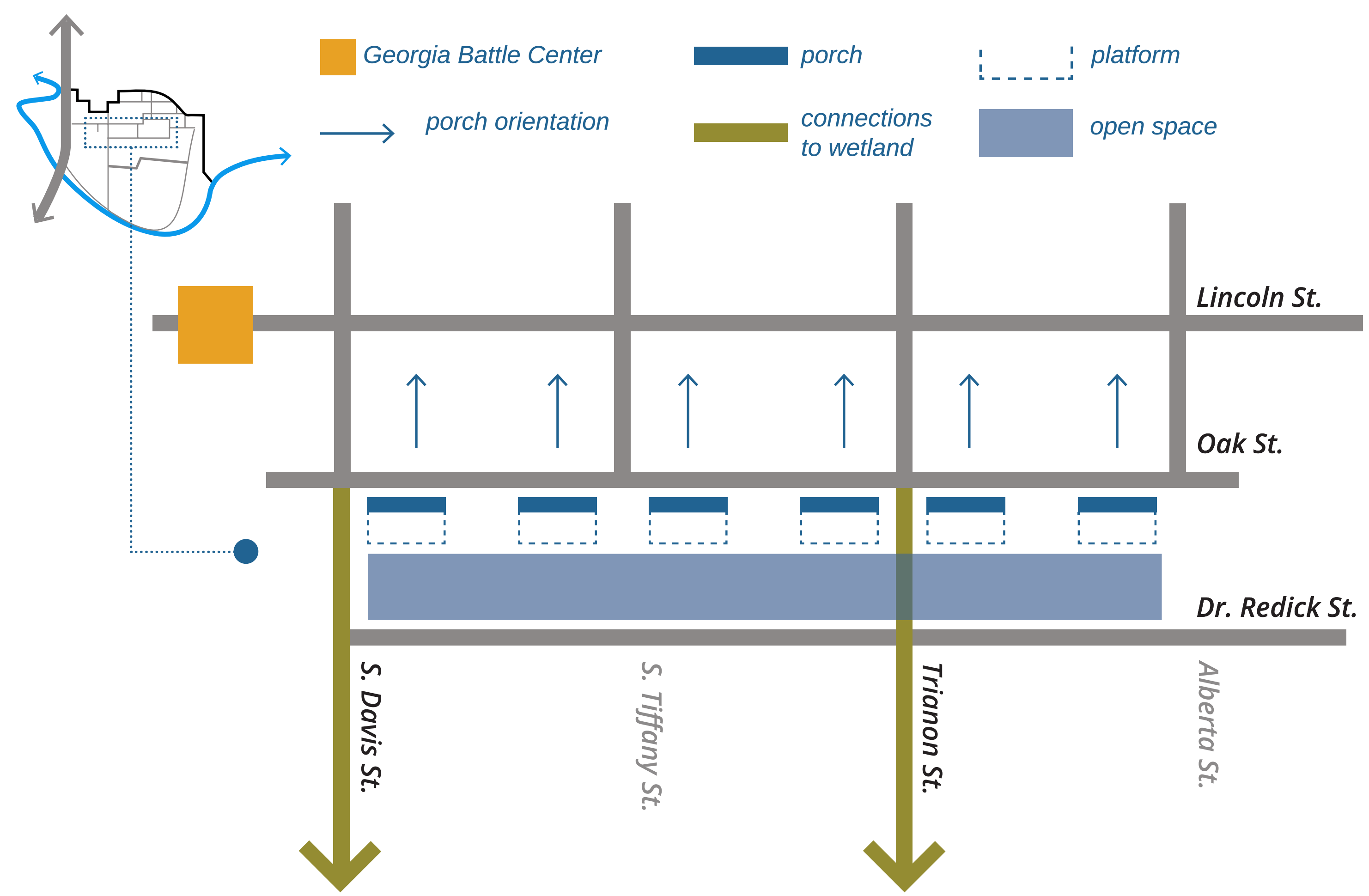
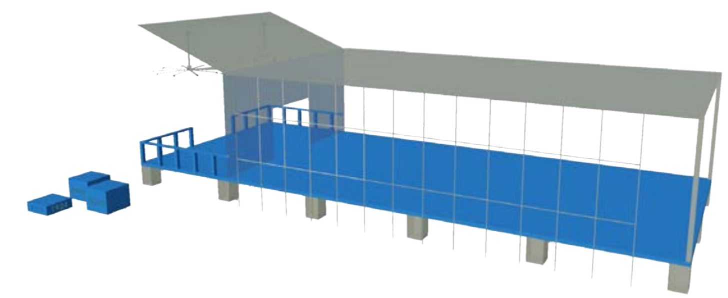


Figure 29: community platform elements

cultural

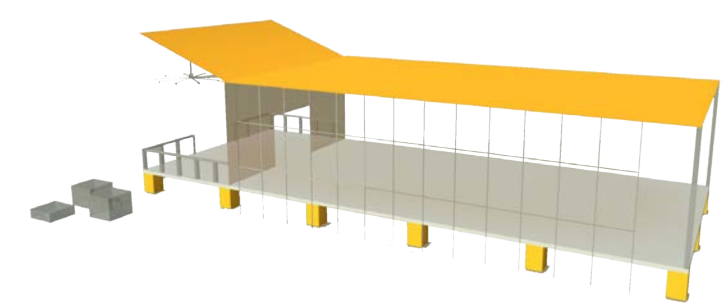


1.
vernacular architecture references familiar building forms

2.
sculptural elements show flood depth of past traumatic events

3.
platforms double as stages for the Lincoln City Reunion

regulatory

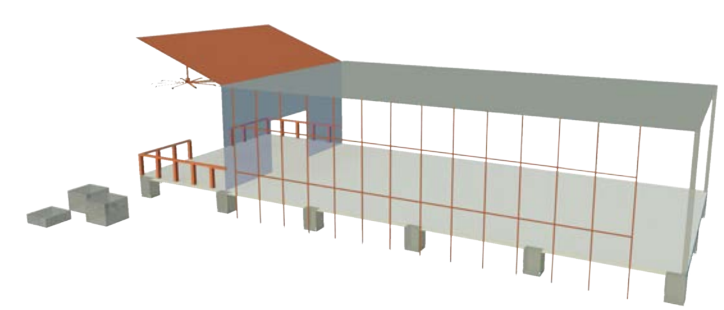


1.
programming is generally compatible with open space, recreational, and wetlands management

2.
stilts elevate floor to 1' above the base flood elevation

3.
structure is open on all sides

health



1.
historic qualities provide stability and peace of mind

2.
plantings can be tailored to mitigate pests during breeding seasons

3.
cooling provided by awnings and outdoor fans

Figure 30: SPECULATIVE ECOSYSTEM SERVICE MODELING IN i-TREE

While the model requires field data to calculate ecosystem service value, it also allows the user to manually adjust existing data to correspond to alternate scenarios. By manipulating the data to represent what a researcher WOULD have found at the initial 10 data points, it is possible to assess the unbuilt scenarious ecosystem service provision, and compare it to the baseline.

EVALUATION

Though this design has clearly not been implemented, it is possible to use i-Tree to evaluate how such a design would perform. Going deeper, by using the same randomly generated data plots in the assessment of both the existing and modified ecosystems, we can then systematically compare that performance (and, by extension, revenue generation) of the proposed design to the pre-intervention context.

After running the i-Tree model for the data that I had gathered in the field, I then manually adjusted the inputs from each of the 10 plots (Figure 30) to correspond to what I would have observed had I visited the buyout zone after the enhanced wetland scheme had been implemented. Because the points were randomly generated and consistent throughout the comparison, there is no element of bias in the analysis. However, because comparatively few points were randomly generated in the southeastern and central portions of the site, this also means that the southwestern portion of the site is disproportionately represented in the analysis. The changes are summarized below. I assumed that the new data would be gathered 10 years after implementation, and that planting would take place in year 0.

Point 1: No change; this part of the upland forest would remain largely unchanged in the new scheme.

Point 2: This wetland would expand significantly, increasing the amount of "water/wetland" in both the land use and wetland inputs. Additionally, the area would have more native riparian wetland tree species like the water tupelo and laurel oaks that were initially observed.

Point 3: Here, an earthen berm would be removed to promote a connection from the neighboring wetland to the river which, during the rainy spring and summer, could facilitate boat access. Additionally, this area would be the outer edge of the wetland phyto-remediation planting regime. Therefore, the amount of "water/wetland" in both the land use and wetland inputs would increase, and the species mix would feature phyto-remediating wetland species like poplars and willows.

Point 4: This portion of the former landfill site would be entirely flooded, replacing the "maintained grass" ground cover with "water/wetland." Additionally, as part of the phyto-remediation wetland, the species mix would go from having no trees to being dotted with maturing poplars and willows.

Point 5: The children's garden would occupy this formerly vacant area of the landfill. Groundcover would go from "maintained grass" to a combination of "herbs" and "mulch/duff." Additionally, while there would still be no trees in this area, there would be an increase in shrub cover, which could change i-Tree's "run-off avoided output."

Point 6: No change; this area would remain a thickly wooded wetland in the new scheme.

Point 7: No change; though much of the surrounding areas would be flooded and repopulated with wetland varieties of trees, shrubs, and groundcover, this point happened to be close to the Norfolk Southern right-of-way, making any significant changes to the landscape impractical.

Point 8: This area, formerly residential blocks in Lincoln City, would be managed for invasive species. These would be replaced with a variety of shrubs and native perennials that could control pests that serve as disease vectors.

Point 9: No change; this part of the upland forest would remain largely unchanged in the new scheme.

Point 10: This area of the Lincoln City Community Park would be reimagined as a grassy lawn area that would serve as a large community gathering space. All observed groundcover and plant species would be transitioned to maintained grass.

After making these changes to each of the data points in the model, I re-ran the i-Tree calculations to determine the value of the ecosystem services provided by the new design. I then compared the value of these modeled ecosystem services to those that are currently provided by the site's existing ecology.

RESULTS

In terms of those services that i-Tree can measure, the design gestures that these ecological changes represent unsurprisingly did not have a significant impact on the overall ecosystem service provision of Kinston's FEMA buyout zone.

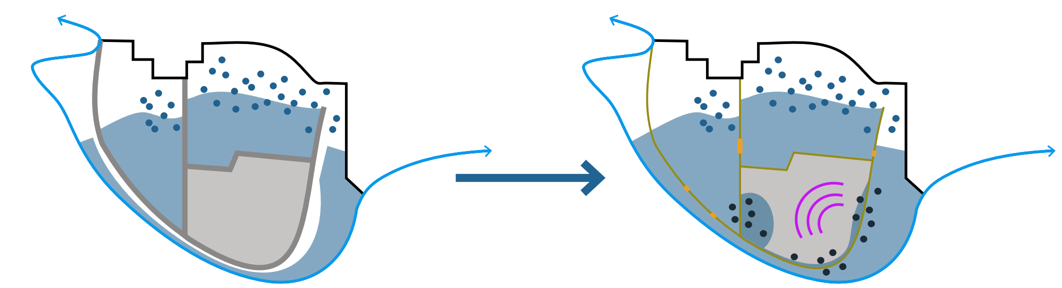
What changes did occur—both increases and decreases in ecosystem service provision—were minor in both scope and economic value (Figure 39). Specifically, the new scheme would increase the buyout zone's annual pollution removal capacity from 9 metric tons/year to 10 metric tons/year, an increase in $1,800/year in saved social costs ($71,000/year to $78,000).The new ecology would also annually sequester 5 more metric tons of carbon compared to the existing conditions (218 metric tons/year vs. 213 metric tons/year), with an added social value of $4,000/year ($171,000 vs. $167,000). In aggregate, the social costs saved by the new scheme's increased ecosystem service provision $5,800/year. These increases in ecosystem service provision under the new scheme are so minor as to be negligible.

However, so too are the two "decreases" in ecosystem service provision between the two schemes. Specifically, the new design is able to store 7,010 metric tons of carbon/year, totaling $550,000 in social cost value. This is 10 annual metric tons less than the 7,020 metric tons ($551,000, a difference of $1,000) that are currently being stored by the site's existing vegetation every year. The decrease is likely due to the conversion of upland forest to the Lincoln City Community Park, which will be largely composed of lawn and shrubs. The new ecology also avoids 140 cubic meters less annual runoff (9,450 cubic meters/year vs. 9,310 cubic meters/year), equating to a mere $100/year in social costs lost under the new scheme. Together, the debits in ecosystem service provision between the current and future state is $1,100/year.

Comparing the credits to the debits yields a net gain of $4,700/year of social value in transitioning to the new scheme. Given the rough approximations involved in sample-based ecosystem service modeling, a difference this small suggests that redesigned scheme would essentially provide the same quantifiable ecosystem services as the undeveloped status quo, which also means that the new scheme could be expected to receive the same amount of compensatory mitigation wetland credits as the current state would. Based on this analysis, the developed masterplan scenario could receive $36,000-$63,000 in actual, spendable wetland credits, while also

Figure 31: CHANGE IN ECOSYSTEM SERVICE PROVISION

Using the methodology described earlier in the chapter, it is clear that the ecosystem services provided by the enhanced wetland scheme will generate even more social value for Kinston than the services operating in the existing conditions. Therefore, it is safe to assume that those ecosystem services will translate into compensatory wetland credits with at least as much market value as those provided unter the status quo.



TYPE OF ECONOMIC VALUE MEASURED	existing ecosystem	*modified ecosystem*
SOCIAL VALUE [from i-Tree]	**pollution removal:** 9 metric tons/year $71,000 **carbon storage:** 7,020 metric tons/year $551,000 **carbon sequestration:** 213 metric tons/year $167,000 **avoided run-off:** 9,450 cubic meters/year $22,000	**pollution removal:** 10 metric tons/year $78,800 **carbon storage:** 7,010 metric tons/year $550,000 **carbon sequestration:** 218 metric tons/year $171,000 **avoided run-off:** 9,310 cubic meters/year $21,900w
DIRECT MARKET VALUE [from EPA estimates derived from in lieu of fee transfers]	**$36,000-$63,000/acre**	at least **$36,000-$63,000/acre**

serving as an amenity to the Kinston community.

Furthermore, as a public amenity, the site would then be able to generate social value (if not actual revenue) through added ecosystem services. For example, given that the site is currently both undeveloped and inaccessible by the public, any recreational activity that would accrue to the redesigned site would be additional recreational activity. Not only does this type of physical activity boost community morale, but it also avoids social costs like healthcare subsidy and hospital operation by promoting healthy lifestyles. Improved recreational facilities like those proposed in the masterplan scenario could also attract tourism dollars to Kinston, thereby stimulating the local economy.

Overall, what this analysis indicates is that financially productive, contextually sensitive, and legally permissible floodplain design is possible in rural North Carolina. By prioritizing revenue generation through ecosystem service provision, planners and designers can implement landscapes that, from an economic perspective, work for their community. And by applying a community design approach to that implementation, they can also help deploy those landscapes in ways that both respond to emergent climate-related issues in public health, and resonate with the users they are intended to serve. This synthetic approach to promoting community resiliency can be instrumental in planning and designing to address the new ecological normal.

1. MAINTAINED CURBS FROM LINCOLN CITY ERA COMMEMORATES PREVIOUS NEIGHBORHOOD INCARNATION

2. SCULPTURAL/SEATING ELEMENTS LOCATED THROUGHOUT THE SITE REPRESENT FLOOD DEPTHS FROM HISTORIC DISASTER EVENTS THAT HAVE OCCURED IN THE NEIGHBORHOOD

3. TRELLIS FEATURE PROVIDES A LEGALLY PERMISSIBLE ENCLOSURE THAT SCREENS SUN IN THE SUMMER, AND CAN BE PLANTED WITH PEST-REPELLENT SPECIES LIKE CITRONELLA.

6. REFLECTIONS

Neuse River wetland:
Wake County, NC

One of the largest and most insidious challenges of engaging resiliency and climate change—be it as a planner or designer, a doctor or petroleum engineer, an artist or farmer, an elected official or simply a member of our species—is having to grapple with uncertainty. 97% of the world's scientists may agree that climate warming trends over the past century are almost surely attributable to human activities (NASA, 2014), but after that, the physical, spatial, and temporal impacts of anthropocentric climate change on people's lives becomes much murkier.

For example, in 2014, the Intergovernmental Panel on Climate Change released their 5th Assessment Report, in which they offered projections for sea level rise between 10-38 inches by the year 2100. This massive range is necessary in part because of political uncertainty concerning the potency of regulations that limit carbon emissions in the immediate future. However, uncertainties in sea level rise are also explainable in uncertainties in climate science: "scientists are still trying to figure out" how quickly the polar ice sheets will melt in the face of climate change (UCS, 2014).

North Carolina illustrates how this unknowing can have sweeping impacts on the physical landscape. In April 2014, the state revised their floodplain maps such that nearly 60% of the buildings in Dare County's floodplain are now considered safe from the risk of storm surge and other forms of coastal flooding. For the local tax base and the development industry, this means fewer state or federal regulatory hurdles to hinder local economic development and tourism-related investments. For those who (at least for regulatory purposes) no longer live in the floodplain, this means a massive reduction in floodplain insurance premiums. For the North Carolinian and American tax-payer, it could mean more bureaucracy and higher taxes to rescue homes on the Outer Banks from the uncertain climatic events of the future.

But beyond the physical ramifications, uncertainty and climate change can also take an as-yet not well understood toll on our collective psychological health. While the issues of displacement and "root shock" discussed in Chapter 2 are undoubtedly powerful emotional threats related to climate change, there are even more pervasive psychological dimensions to the new ecological normal.

Almost by definition, living a life suffused with uncertainty means living a life with little stability, few constants, and rapidly crumbling assumptions about the ecological world we share with other living beings. The Japanese word *mottainai*—regret over wastefulness of a resource—hints at the unique dynamic between climate change and mental health. But even deeper than the human-centered notions of losing a resource, something that exists because of its utility and benefit to our species, I believe that there are non-anthropocentric dimensions to climate change's psychological toll. Either consciously or subconsciously, our entire species is busy trying to reckon with grim and pathological realities—from the pending disappearance of charismatic megafauna like polar bears and elephants to the upending of the seasonal cycles that we've depended on our whole lives. We are trying to live with the knowledge that we are responsible for remaking our planet's functions, and that, if it isn't already, the life of every single creature on the planet will be different soon because of it.

SCALED UP: BROAD IMPLICATIONS

This project has pointed to ways of using the landscape as a tool for addressing this uncertainty in a rural context. In some ways, FEMA and the host of local and state actors involved in the buyout program already did a lot of the hard work. By acquiring and placing significant restrictions on properties that are likely to continue suffering flood damage, the buyouts injected some certainty into Kinston's floodplain. Regardless of science or politics, this area of the Kinston community will forever remain "only for purposes compatible with open space, recreation, or wetlands management practices." This project demonstrates a way of operating within these parameters to generate revenue for a community that needs it while also, and indeed *because* it is capable of, producing a landscape that can function with either 10 or 38 inches of sea level rise. By applying a framework of ecosystem service valuation and monetization to their landscape, Kinston and communities like it around the world can begin to view hazardous, marginalized, and otherwise loaded parcels as resources to promote resiliency.

And by incorporating collective memory and community placemaking into the design process, this project has also demonstrated potential pathways for landscape architects and planners to address the perhaps nebulous but no less critical psychological issues associated with uncertainty and a changing climate. Not only can community amenities help provide important social and cultural services by, say, disseminating healthy food and promoting recreation, but they can serve as monuments to and testaments of the vestiges of the human experience that are threatened by climate change. This is more pressing in some places than others—for example, due to sea level rise, the island nation of Kiribati is literally disappearing—but both the significance of this task, and the unique capacity of landscape architecture to contribute to it are meaningful and likely emergent pursuits for future planners and designers.

Ultimately though, this project has demonstrated how we can think about existing human and ecological environments as resources that can actually be used to promote more resilient communities. This work has honed in on how a pragmatic interplay between people and ecology could look in one specific rural community, but the framework is applicable elsewhere. By pairing an environmental design process that focuses on revenue generation through ecosystem service provision with a community design process that focuses on history, memory, and story-telling, planners and designers can ensure that the safety, vitality, and longevity of our communities won't change along with the climate.

SCALED DOWN: KINSTON IMPLICATIONS

If Kinston chooses to pursue the framework outlined in this masters project, the extent to which the community can harness the economic and placemaking potential of the buyout zone will depend on how effectively it establishes governance systems to manage wetland credit monetization. Even larger, higher-resource communities like Charlotte struggle to navigate through the intricate and shifting web of policies and relationships at various levels of government that are necessary to implement a municipal wetland mitigation bank as recommended here. This work provides a roadmap for Kinston to begin peeling back the layers of regulations that govern municipal wetland banking. A complete understanding of these environmental and financial governance issues will enable the city to build effective and targeted partnerships with the public, private, non-profit, and institutional partners needed to implement and maintain a municipal wetland bank.

Additionally, a broader, more inclusive community engagement process will be necessary to determine the character of any community amenity that might occupy the former Lincoln City neighborhood. The community design strategy outlined in Chapter 4 was intended to solicit specific, place-based cues for both the formal and story-telling dimensions of the proposed Lincoln City Community Park, and was therefore targeted to those members of the Kinston community who can best speak to those aspects of the neighborhood. But while a community amenity in the remnants of the Lincoln City neighborhood should feature and indeed be driven by input from those with the strongest ties to the site's history, any public park should be designed to serve the entire public, which in this case would be the residents of greater Kinston. For the development of the proposed park to proceed, Kinston would need to devise and enact an expanded community engagement strategy that, while building on the one detailed in this project, accesses a larger and more representative slice of the intended user group.

Finally, while attention was paid to connect the proposed amenity to existing community resources within the immediate vicinity of the buyout zone, Kinston should consider ways of linking a redesigned buyout zone to the emergent commercial and cultural revitalization taking place around the city's downtown core. Though nascent, the city-supported success of business owners like Stephen Hill of Mother Earth Brewing and restauranteur Vivian Howard show promise as potential economic development strategies, rebranding Kinston as a regional destination for culinary and cultural visitors. As these efforts begin to spill out into the renovation of additional commercial and residential properties in and around downtown Kinston, it will be critical for the city to connect this measured economic growth to the community's traditionally marginalized southern boundaries. By integrating a redesigned buyout zone into these and other emergent trends in economic development, Kinston can leverage its ecological and cultural resources to plan and design for community resiliency, no matter that the future may look like.

APPENDIX

NOTES ON i-TREE ECO METHODOLOGY + CALCULATIONS

The following is taken from the i-Tree report that accompanied the baseline ecosystem service assessment. Additional information about the i-Tree Eco methodology can be found in the user manual, available online at http://www.itreetools.org/resources/manuals.php.

To calculate current carbon storage, biomass for each tree was calculated using equations from the literature and measured tree data. Open-grown, maintained trees tend to have less biomass than predicted by forest-derived biomass equations. To adjust for this difference, biomass results for open-grown urban trees were multiplied by 0.8. No adjustment was made for trees found in natural stand conditions. Tree dry-weight biomass was converted to stored carbon by multiplying by 0.5.

To estimate the gross amount of carbon sequestered annually, average diameter growth from the appropriate genera and diameter class and tree condition was added to the exis ing tree diameter (year x) to estimate tree diameter and carbon storage in year x+1. Carbon storage and carbon sequestration values are based on estimated or customized local carbon values. For international reports that do not have local values, estimates are based on the carbon value for the United States and converted to local currency with userdefined exchange rates. Carbon storage and carbon sequestration values are calculated based on $78 per metric ton.

Annual avoided surface runoff is calculated based on rainfall interception by vegetation, specifically the difference between annual runoff with and without vegetation. Although tree leaves, branches, and bark may intercept precipitation and thus mitigate surface runoff, only the precipitation intercepted by leaves is accounted for in this analysis. The value of avoided runoff is based on estimated or user-defined local values. The U.S. value of avoided runoff is based on the U.S. Forest Service's Community Tree Guide Series.

Air pollution removal estimates are derived from calculated hourly tree-canopy resistances for ozone, and sulfur and nitrogen dioxides based on a hybrid of big-leaf and multi-layer canopy deposition models. As the removal of carbon monoxide and particulate matter by vegetation is not directly related to transpiration, removal rates (deposition velocities) for these pollutants were based on average measured values from the literature that were adjusted depending on leaf phenology and leaf area. Removal estimates of particulate matter less than 10 microns incorporated a 50 percent resuspension rate of particles back to the atmosphere. Recent updates (2011) to air quality modeling are based on improved leaf area index simulations, weather and pollution processing and interpolation, and updated pollutant monetary values.

Air pollution removal value was calculated based on local incidence of adverse health effects and national median externality costs. The number of adverse health effects and associated economic value is calculated for ozone, sulfur dioxide, nitrogen dioxide, and particulate matter <2.5 microns using the U.S. Environmental Protection Agency's Environmental Benefits Mapping and Analysis Program (BenMAP). Pollution Removal value is calculated based on the prices of $1,253 per metric ton of carbon monoxide, $2,242 per metric ton of ozone, $321 per metric ton of nitrogen dioxide, $140 per metric ton of sulfur dioxide, $12,864 per metric ton of particulate matter less than 10 microns and greater than 2.5 microns, and $98,656 per metric ton of particulate matter less than 2.5 microns.

Agrawal, A. 2008. The role of local institutions in adaptation to climate change. Ann Arbor, MI: International Forestry Research and Institutions Program. 47: 3–28.

Bedford, B. L. 1996. The need to define hydrologic equivalence at the landscape scale for freshwater wetland mitigation. Ecological Applications 6:57–68.

BenDor, T., Brozovic, N., and V. G. Pallathucheril. 2008. Exploring the social impacts of wetland mitigation policies in the United States. Journal of Planning Literature 22:341–357.

BenDor, T., Sholtes, J., and Doyle, M. W. 2009. Landscape characteristics of a stream and wetland mitigation banking program. Ecological Applications, 19(8), 2009, pp. 2078–2092.

BenDor, T., Stewart, A. 2011. Land use planning and social equity in North Carolina's compensatory wetland and stream mitigation programs. Environmental Management, 2011 Feb;47(2):239-53.

Berke, P. and Campanella, T. 2006. Planning for Postdisaster Resiliency. Annals of the American Academy of Political and Social Science, Vol. 604, Shelter from the Storm: Repairing the National Emergency Management System after Hurricane Katrina (Mar., 2006), pp. 192-207

Birkland, Thomas. 1997. After disaster: Agenda setting, public policy, and focusing events. Washington, DC: Georgetown University Press.

Boone, Kofi. 2012 "Cellphone Diaries: Mobile Technology and Self-Authored Digital Videos in Asset Mapping." PRISM: Journal of Regional Engagement, Fall 2012.

Brown, T.C., Bergstrom, J.C. and Loomis, J.B. 2007. Defining, Valuing, and Providing Ecosystem Goods and Services. Natural Resources Journal, 47(2): 331-76.

Costanza, Robert et. al. 15 May 1997. "The Value of the World's Ecosystem Services and Natural Capital." Nature 387: 253-259.

Solnit, Rebecca. 2010. A Paradise Built in Hell: The Extraordinary Communities That Arise in Disaster. New York; Penguin Books.

Eriksen, S.; Klein, R.; Ulsrud, K.; Naess, L.O.; O'Brien, K. 2007. "Climate change adaptation and poverty reduction: key interactions and critical measures." Oslo, Norway: Norwegian Agency for Development Cooperation: 4–43.

Forbes Magazine. "America's Fastest Growing Cities in 2015." http://www.forbes.com/pictures/emeg45eegeg/4-raleigh-n-c/

Fullilove, Mindy Thompson. 2005. Root Shock: How Tearing Up City Neighborhoods Hurts America, and What We Can Do About It. One World/Ballantine (New York).

Godschalk, D, T. Beately, P. Berke, D. Brower, and E. Kaiser. 1998. Natural Hazard Mitigation; Recasting Disaster Policy and Planning. Island Press (New York).

Hahn, Alan J. 1970. Planning In Rural Areas. Journal of the American Institute of Planners, 36:1, 44-49.

Hawken, P., Lovins, A. B., and Lovins, L. H. 1999. Natural Capitalism: Creating the Next Industrial Revolution. New York; Little Brown and Company.

Haya, Barbara. 2008. Compilation of evidence that the majority of projects in the CDM are nonadditional. Carbon Offset Research and Education. http://www.co2offsetresearch.org/PDF/AdditionalityLackCDM.pdf.

Hester, Randolph T. 1990. Community Design Primer. Mendocino; Ridge Times Press.

Hester, Randolph T. 2006. Design for Ecological Democracy. Cambridge; MIT Press.

Hou, Jeffrey and Michael Rios. 2003. Community-driven Placemaking: the Social Practice of Participatory Design in the Making of Union Point Park. Journal of Architectural Education, 57 (1): 19-27.

i-Tree Tools for Assessing Community Forests. 2015. "i-Tree Resources." http://www.itreetools.org/resources/index.php

Karl, Jarrod J. "The Future of Mitigation in Charlotte." 19th Annual Southeastern Lakes Management Conference. May 7, 2010. http://www.nclakemanagement.org/conferences/presentations/SE-19May2010/Karl_NCLM_2010.pdf.

Keller Jensen, J. 2009. Climate change and rural communities in the U.S. Columbia, MO: Rural Policy Research Institute. www.rupri.org/Forms/Climate_Change_Brief.pdf.

Kuhl, L., Kirshen, P., Ruth, M., and Douglas, E. 2014. Evacuation as a climate adaptation strategy for environmental justice communities. Climatic Change: An Interdisciplinary, International Journal Devoted to the Description, Causes and Implications of Climatic Change. (2014) 127:493–504.

L&C Carbon LLC. 2015. "What does ARB require for a forest carbon project to be eligible?" http://www.lccarbon.com/faq

Lyles, Ward. 2014. Using social network analysis to examine planner involvement in environmentally oriented planning processes led by non-planning professions. Journal of Environmental Planning and Management. 6 Nov. 2014.

Lynn, Kathy, MacKendrick, Katharine, and Donoghue, Ellen M. 2011. "Social Vulnerability and Climate Change: Synthesis of Literature." United States Department of Agriculture. General Technical Report PNW-GTR-838. August 2011.

McCann, Monica Olivera. 2006. Case Study of Floodplain Acquisition/Relocation Project in Kinston NC after Hurricane Fran (1996) and Hurricane Floyd (1999). Masters project; University of North Carolina at Chapel Hill, Department of City and Regional Planning.

Mcrea, Lynne. Thirteen VT Towns Isolated After Storm. Vermont Public Radio. 30 Aug. 11. http://www.vpr.net/news_detail/91809/thirteen-vt-towns-isolated-after-storm/

Miranda, Marie Lynn, Hastings, Douglas A., Aldy, Joseph E. and Schlesinger, William H. The Environmental Justice Dimensions of Climate Change" Environmental Justice. March 2011, 4(1): 17-25.

NASA. 2015. "Consensus: 97% of climate scientists agree." http://climate.nasa.gov/scientific-consensus/

Pittman, J. and McCormick,R.J. 2010. Ecosystem Service Valuation Concepts and Methods. In: Kapustka, L. and Landis, W.G. (Eds), Environmental Risk Assessment and Management from a Landscape Perspective. John Wiley and Sons.

Race, M. S., and M. S. Fonseca. 1996. Fixing compensatory mitigation: what will it take? Ecological Applications 6:94–101.

Research Triangle Environmental Health Collaborative. 2013. Public Health and Climate Change: Focusing North Carolina Forward. Report on the 2013 Environmental Health Summit. http://environmentalhealthcollaborative.org/images/RTEHC_2013_Climate_Change_Summit_Recommendations.pdf

Sanoff, Henry. Design Games. New York; William Kaufmann Press, 1st Edition (1979.)
Sanoff, Henry. Integrating Programming, Evaluation and Participation in Design. Belfast; Avebury Press (1992).

Schmidt, Amelia. 2012. Investing in Natural Capital: Estimating the Value of Open Space Nature Preserves in Wake County, North Carolina Masters Project, NCSU Department of Natural Resources.

Schulz, A.J., Williams, D.R.; Israel, B.A.; Lempert, L.B. 2002. Racial and spatial relations as fundamental determinants of health in Detroit. The Milbank Quarterly. Hoboken, NJ: Wiley-Blackwell. 80(4): 677–707.

Spash, C.L. and Vatn, A. 2006. Transferring environmental value estimates: Issues and alternatives. Ecological Economics 60(2006): 379-88.

Templeton, S. R., C. F. Dumas, and W. T. Sessions. 2008. Estimation and analysis of expenses of design-bid-build projects for stream mitigation in North Carolina. Department of Applied Economics and Statistics, Clemson University Research Report RR 08-01. http://cherokee.agecon.clemson.edu/curr0801.pdf

Trainor, Sarah F., Chapin, Stuart, Huntington, Henry, Natcher, David C., and Kofinas, Gary. 2007. Arctic Climate Impacts: Environmental Injustice in Canada and the United States. Local Environment 12.6. (Dec 2007): 627.

Tsosie, Rebecca A. 2007. Indigenous People and Environmental Justice: The Impact of Climate Change. University of Colorado Law Review, Vol. 78, p. 1625, 2007.

Union of Concerned Scientists. "What Are the Range of Possibilities for Sea Level Rise Projections?" July 2014. http://www.ucsusa.org/publications/ask/2014/sea-level-rise.html#.VRK2qfnF98E

US Department of Energy. "Interactive Hurricane Sandy Disruption Map." http://www.eia.gov/special/disruptions/hurricane/sandy/

US Department of Housing and Urban Development. Promoting Resilience Post-Sandy Through Innovative Planning and Design. http://portal.hud.gov/hudportal/documents/huddoc?id=REBUILDBYDESIGNBrief.pdf

USA Today. Hurricane Sandy, Drought Costs US $100 Billion. 25 Jan. 2013. http://www.usatoday.com/story/weather/2013/01/24/global-disaster-report-sandy-drought/1862201/

Williams, D.R.; Collins, C.A. 2001. Racial residential segregation: a fundamental cause of racial disparities in health. Public Health Reports. 116: 404–416.

Zedler, J. B. 1996. Ecological issues in wetland mitigation: an introduction to the forum. Ecological Applications 6:33–37.